FRANCISCI BACONI

DE VERULAMIO,

SUMMI ANGLIÆ CANCELLARII,

NOVUM ORGANUM,

SIVE

INDICIA VERA

DE

INTERPRETATIONE NATURÆ.

OXONII:
E TYPOGRAPHEO ACADEMICO.
M.DCCC.LV.

NOVUM ORGANUM:

SIVE

INDICIA VERA

DE

INTERPRETATIONE NATURÆ.

EDITED,

WITH ENGLISH NOTES AND APPENDICES,

BY THE

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X

INTRODUCTION.

THE NOVUM ORGANON was first published in the year 1620, five years before the death of its great author. He was, consequently, advanced in years, when he placed before the eyes of men this portion of the work of which he had dreamed and thought almost from his earliest days. He had, when quite a youth, sketched out the plan of it, giving to it the ambitious title of "Partus temporis maximus;" and although he afterwards withdrew this high-sounding name, it does not appear that he thought the less of his work, or doubted that it would produce effects to be felt throughout all time. We have the testimony of Rawley, in his Life of Bacon, to the care and thought expended upon it; "I myself," says the biographer, "have seen at the least twelve copies of the Instauration, revised year by year one after another, and every year altered and amended in the frame thereof, till at last it came to that model in which it was committed to the press, as many living creatures do lick their young ones, till they bring them to their strength of limbs." Besides this, Bacon was at the pains to bring out sketches of parts of the Instauration; some of which are extant, others not. Thus we have a fragment entitled "De Interpretatione Naturæ;" another called "Cogitata et visa," which contains many of the Aphorisms of the first book of the Novum Organon, and a "Filum Labyrinthi;" beside the "Parasceue," a preparation for the 3rd part of the Instauration, and many other imperfect pieces. His object in sending

these forth into the world was, apparently, to prepare men's minds for the great work, whose object and character were so unlike what was ordinarily taught in those days, that he deemed it necessary not to produce it too suddenly or boldly. As it was, the Novum Organon was not well received at the first. The king made a joke on it, as jokes were then wont to be made, rather witty and very profane; sir E. Coke made bad rhymes against it; even sir T. Bodley censured it; people generally seemed to suppose it was something to admire, something very deep; and in an awkward way they tried to admire;—as indeed they have gone on doing till within the last half century. It was the fashion to acquiesce in Bacon's greatness, but it was anything but the custom to verify his reputation by the study of his works. The book had at first more honour abroad than at home; and, as so often happens when men's minds are not equal to that which is set before them, the illustration of the Method (viz. Nov. Org. II. 11–20) attracted infinitely more attention than the Method itself, and than those noble jewels of thought which lie scattered thickly over the surface of the earlier portion of the work. The discussion of the Form of Heat was reprinted separately; and the cumbrous system of Tables there pourtrayed, together with the vague conclusions arrived at, were held up to universal admiration. A more intelligent respect for Bacon is gradually taking the place of this faulty and blind reverence; and while men criticise the flaws in the structure of that noble mind, they also, let us hope, give all the more hearty praise to the marvellous excellences which it displays.

The Novum Organon was but a little fragment. In it, indeed, are contained those principles and thoughts which occupied Bacon's mind all his life through: and we cannot be far wrong in considering the 1st book and the opening of the 2nd as the most important of all his philosophical writings. They certainly lift the veil which hangs over his conception of the realm of knowledge, and, though it is but a description of

the Method, a mere instrument for the discovery and explanation of truth, still it contains so much deep thought, and so many valuable incidental statements, that it must be ranked very high among the books which make up the literary heritage of England. I said that it is but a fragment. For he sketched out a perfect work, of which it was to be quite an inferior part: and even of that part, the book, as we have it, contains only a small portion. He purposed to divide the "Instauratio Magna" (for this is the title of the whole) into six parts; and from the Preface to it, (which, unlike most authors, he wrote first,) and from the "Distributio Operis," we have full information of his object, and of the intention of each of these six parts.

(1). First came the "Partitiones Scientiarum," a map of knowledge, as it was at the time; a brief description of the existing state of the whole of learning; with its deficiencies noted, its divisions marked out, and due credit given to what was good. This, an introduction to the whole, to map out the whole land, which Bacon hoped to colonise and cultivate, was first sketched out in the Advancement of Learning, and afterwards published at much greater length in Latin in the "De Augmentis Scientiarum," in the year 1623. This division alone was completed.

(2). Next came the Novum Organon; the new Instrument (or Logic, as he delights to call it) by whose means Nature may be induced to yield up her secrets for the good of man. It was to commence with a *destructive* treatise; a treatise which should clear away the phantoms and illusions which had crowded thickly around knowledge: there was to follow a very brief account of the object on which this new instrument was to be employed; then, in detail, descriptions of the nine "auxilia intellectus," which were to assist the mind in the *Interpretation of Nature*, and in true and perfect *Induction*. (Nov. Org. II. 21.) Of these nine parts but one is complete; and of the others hardly any trace remains. And it should always be

remembered by those who criticise the Method of the philosopher, that of that Method only a very small part has been laid before us. The Novum Organon, then, is *instrumental*, and puts into men's hands the means by which they may successfully appeal to Nature.

(3). The third division, which he entitled "Phænomena Universi," was intended to be a vast collection of observed facts, and of results of experiments, with a view to the building up of a new Philosophy. These were to be gathered by the industry of men; and to be sorted and sifted by the Method or Instrument provided.

(4). The fourth part of the Instauration, called the "Scala Intellectus," seems to have been intended for the preservation, in the exact order of their discovery, of some of the most striking of the results of the new Method: illustrations, in fact, of those chapters in the Nov. Org. (I. 100—105.) which point out the ascending and descending character of the Baconian Induction.

(5). Next was to follow a specimen of that new philosophy, to which all was to be introductory, and which was to crown the whole. "Prodromi sive Anticipationes Philosophiæ secundæ." These seem to have been intended partly to prepare the mind for the new Philosophy, so that men should not be entirely dazzled when that so bright light broke upon them; and partly, "tanquam fœnus, usque dum sors haberi possit" (Distrib. Operis), to be a pledge of results, and to console the eagerness of mankind; lest weary with so long preparation, and desiring the comforts and "fruit" of civil life, they should abandon the new way, and walk on contentedly in the narrow never altering limits of the old paths.

(6). And lastly, we have the "Philosophia secunda, sive Scientia activa;" a complete system of Philosophy; an Encyclopædia of all knowledge, duly arranged; in fact, a summary of all that the Sciences have done or can do towards enlarging the limits of man's Knowledge or his Power. This last branch,

stretching, as it was intended to do, across the whole domain of knowledge, Bacon was fain to confess, lay beyond his skill and power; and he left it to posterity to be filled up. It is as though his "Instauratio Magna" gradually enlarged its borders, and from beginning as a book ended as knowledge itself. It is, indeed, doubtful whether he believed that this part would ever take the form of a book at all.

Thus then it appears how small a portion of the great scheme is filled up: and of that small portion filled up, what a little piece is that which the Novum Organon covers!

But in the history of the world's growth it holds a prominent place. He who was "ad literas potius quam ad aliud quicquam natus, et ad res gerendas nescio quo fato contra genium suum abreptus," (De Augm. Scient. VIII. 3.) has by posterity been restored again to his proper sphere. The sad history of his political career is indeed now attacked and now defended; but it has ceased to occupy the minds of men. Francis Bacon lives as a Philosopher, not as a courtier, in the imperishable memorials of his genius. And yet he was not the first man who advocated or who practised an experimental method; nor are his thoughts always original, or always just. His glory is that he seized the truths which were beginning to emerge from the darkness of the days that were past; that he adorned them with a genius and a poetry which remind us of the beauties of Plato; that he boldly attacked systems supported by the strength of logical precision, and backed by the authority of centuries and the opinion of millions; that he was peculiarly gifted to see the connections of different sciences one with another; that he recognised the relationship in which the human mind stands towards the outer world; that he had almost a prophetic foresight; and, finally, that he loved Nature, as "the handmaid of Religion," and had a consistent and unchanging aim before him—the appeal to facts as they are in the world rather than to theories or speculations, and the belief that Nature will not mislead those who go to her

for knowledge—since by Nature we mean the hand of God Himself.

And, as I have before said, the Novum Organon is the instrument to be used for this end. It is the means of preparing us for the entry of Truth. The Intellect is to be purified, and levelled, so that, like a polished mirror, (to use Bacon's own simile,) it may reflect with truth the rays of light which fall upon it.

Nor do I know any higher praise that can be given to Bacon than that Newton evidently had studied his works deeply, used his terms, and practically carried on the work he had begun; verifying many of his guesses, and interpreting triumphantly the facts of Nature, into whose constitution he had obtained a deep and true insight.

And yet as a Method the Novum Organon cannot be said to be successful—it certainly is not followed at this day as such: it did its work, and has been superseded; and if we were to study Bacon for the sake of the Method, we should become subject to "Idola Theatri" almost as untrue and dangerous, as those against which he himself fights so manfully in the first book. We may look into the method as a matter of curiosity; but we must not endeavour, I think, to accept or to apply it.

What then? Is the use of the Novum Organon thus to be narrowed in its limits? And is it worth our while to spend labour on it, if it is but a matter of curiosity, and has even a tendency to lead us astray? These are questions which naturally suggest themselves, and deserve consideration.

In the first place, I need not repeat myself as to the intrinsic worth of much of the Novum Organon. No one who has studied the work with any attention can fail to recognise this. Every sentence, in a great part of the book, is pregnant with suggestions and thoughts which will richly repay us for the labour expended on it. Secondly, there is enough difficulty in the manner in which the book is put together to make it, on

that score, excellent practice for students; a great part of whose education, it should ever be remembered, lies in obtaining the power of grasping the truths contained in books in the best way, i. e. in the power of reading with attention and profit; by no means one of the easiest parts of education. And, thirdly, though the method of the Novum Organon is erroneous, or, at least, inapplicable, as a whole; parts of it (as, for example, the "scala ascensoria et descensoria,") are most admirable; and are of constant use in the progress of the sciences.

I trust then that I shall be pardoned if I spend a little time in detailing the manner in which I believe the Novum Organon may be best studied; and in recommending a few of the works which may be profitably read with it.

First; it will be well to limit the amount to be studied. There is a natural division of the book, as near the middle as possible; and the two halves may be taken quite separately. Physical students, who from curiosity take an interest in the history of the growth of natural sciences, will find much to repay them in the latter half of the Book. For although many of the "Prerogative Instances" are fanciful, and some are confused; and though the examples adduced are such as now would not be allowed; still many of the chapters contain very judicious hints and statements; and some of the Instances (such as, for example, the *glaring* or the *crucial*) are extremely useful in physical discovery at this day. There are, too, guesses and suggestions, which have since been verified: and as a curious record of the state of knowledge at the beginning of the seventeenth century, these Aphorisms (II. 22—52) are worthy of attention.

But the general reader will be content to give a rapid glance at these latter Aphorisms, and will spend his time chiefly on the first Book and the first ten Aphorisms of the second; for these contain the valuable part of the work. The "vindemiatio prima de forma calidi," (i. e. II. 11—20) will

scarcely detain any one very long. It is an illustration briefly given of the first steps of the process as Bacon proposed it: and if these Aphorisms did not contain some statements as to the usage of the term *Form*, they would scarcely deserve any recommendation—for the subject of Heat is of course far better treated in such works as Turner's Chemistry, or even in Herschel's Discourse on the Study of Natural Philosophy.

The First Book is almost entirely preparatory. From Aph. 1—37 we have some general introductory statements; from Aph. 38—92 we are employed on the clearance of hindrances; Aph. 93—115 give us the "grounds of Hope;" and Aph. 116—130 are employed in answering objections and doubts which might be urged against the new Method. Then in Book II. 1—10 we have a very brief account of the ends proposed; the discovery of *Latent Process, Latent Structure*, and finally, (the crown of all) of *Form*.

The student will do well first to read all this rapidly, and in the English; so as to obtain a general conception of Bacon's style of thinking and of his object: then he may take the Latin Text, (for no translation can do justice to it, or stand in its stead); and read it carefully and thoughtfully. Bacon's language, like the secret things of Nature, will not unfold all its treasures to the hasty passer-by: he who will learn his full meaning and worth must first sojourn with him and become his friend.

I know no better commentary on the Novum Organon than Sir J. Herschel's Discourse. It provides frequent illustration and example; but, above all, it contains a fair and clear exposition of that modern method of interrogating Nature, which has its origin in Bacon's writings; though the growth of Natural Philosophy has led men to abandon the pursuit of that method which Bacon recommended to notice. In Playfair's Dissertation in the Encycl. Brit. (Preliminary Volume) will be found an analysis of the work, with many valuable observations. There is also an account of the Nov. Org. published

in the Library of Useful Knowledge, which, though scarcely correct in its divisions of the work, &c., is still worthy of being consulted. But no student should neglect Dugald Stewart's Philosophy of the Human Mind. No philosophical writer has ever studied Bacon with greater profit: he was among the first who raised the minds of men, and led them to look into Bacon's writings, and to judge for themselves, and to profit from them. They whose turn of mind leads them that way, will find that Sir I. Newton's writings are those of a man who was well acquainted with the mind and phraseology of Bacon. Nor may we omit Bp. Butler's Sermons—a grand application of the Inductive principles of observation to the study of man's moral nature.

I mention these works, because in the Notes subjoined to this volume I have illustrated chiefly from them; thinking it better to do so, as they are likely to be in most students' reach. In those notes I have endeavoured simply to explain and illustrate the meaning of the Author, and to point out some of the lines of thought which he suggests; and this I have done specially with a view to those branches of education which are chiefly followed at Oxford. From German metaphysicians I have taken nothing; partly because I am but scantily acquainted with them; but still more because it does not seem to me that their mind and way of thought have anything really in common with Bacon's. And I trust that wherever error may be noticed, allowance will be made; for a first attempt at illustrating so varied and so profound an Author must be both defective and liable to mistakes. It is a matter of astonishment to me that no extensive collection of notes should have hitherto been made on the Novum Organon, or indeed on any part of Bacon's writings. Let me hope that, having made the attempt, I may thereby induce others to go on with it.

This edition was undertaken principally at the request, and with the advice of one to whom I had hoped to have submitted

it for approbation before it went out into the world. It has pleased God that it should be otherwise. Instead of it, I have but the melancholy satisfaction of expressing my gratitude for the kindness, and my sorrow at the sudden removal of the late Dean of Christ Church.

My thanks are due to many friends who have helped me, and shewn an interest in the work which has been my companion, my amusement, and often my solace, during the last year; and I am especially under obligations to the Rev. T. V. Bayne, M.A., Student of Christ Church, for the valuable assistance which he gave me with much patience and expense of time, during the revision of the translation. My thanks are also due to my friend and pupil, R. Southey, Esq., whose counsel was of the greatest service to me in the composition of such of the notes as refer to Physical Sciences.

It only remains for me to commend this volume to the public, with the hope that the study of Bacon's writings will afford them the same pleasure and profit which it has given me.

CHRIST CHURCH,
June 7, 1855.

THAT PART OF THE

DISTRIBUTIO OPERIS

WHICH RELATES TO THE NOVUM ORGANON.

Ejus constituuntur Partes sex.

Prima; Partitiones Scientiarum.

Secunda; Novum Organum, *sive* Indicia de Interpretatione Naturæ.

Tertia; Phænomena Universi, *sive* Historia naturalis et experimentalis ad condendam Philosophiam.

Quarta; Scala Intellectus.

Quinta; Prodromi, *sive* Anticipationes Philosophiæ secundæ.

Sexta; Philosophia secunda, *sive* Scientia activa.

——— Porro prætervecti artes veteres, intellectum humanum ad trajiciendum instruemus. Destinatur, itaque, parti secundæ doctrina de meliore et perfectiore usu rationis in rerum inquisitione, et de auxiliis veris intellectus; ut per hoc (quantum conditio humanitatis et mortalitatis patitur) exaltetur intellectus, et facultate amplificetur ad Naturæ ardua et obscura superanda. Atque ea est, quam adducimus, ars (quam *Interpretationem Naturæ* appellare consuevimus) ex genere Logicæ; licet plurimum, atque adeo immensum quiddam, intersit. Nam et ipsa illa Logica vulgaris auxilia et præsidia intellectui moliri ac parare profitetur: et in hoc uno consentiunt. Differt autem plane a vulgari, rebus præcipue tribus; viz. ipso fine, ordine demonstrandi, et inquirendi initiis.

Nam huic nostræ Scientiæ finis proponitur, ut inveniantur non Argumenta, sed artes; nec principiis consentanea, sed ipsa principia; nec rationes probabiles, sed designationes et indicationes operum. Itaque ex intentione diversa, diversus sequitur effectus. Illic enim adversarius disputatione vincitur et constringitur; hic Natura opere.

Atque cum hujusmodi fine conveniunt demonstrationum ipsarum natura et ordo. In Logica enim vulgari opera fere universa circa syllogismum consumitur. De Inductione vero dialectici vix serio cogitasse videntur; levi mentione eam transmittentes, et ad disputationis formulas properantes. At nos demonstrationem per Syllogismum rejicimus, quod confusius agat et Naturam emittat e manibus. Tametsi enim nemini dubium esse possit, quin, quæ in medio termino conveniunt, ea et inter se conveniant, (quod est mathematicæ cujusdam certitudinis); nihilominus hoc subest fraudis, quod Syllogismus ex propositionibus constet, propositiones ex verbis, verba autem notionum tesseræ et signa sint. Itaque si notiones ipsæ mentis, (quæ verborum quasi anima sunt, et totius hujusmodi structuræ et fabricæ basis) male ac temere a rebus abstractæ et vagæ, nec satis definitæ et circumscriptæ, denique multis modis vitiosæ fuerint, omnia ruunt. Rejicimus igitur Syllogismum; neque id solum quoad principia (ad quæ nec illi eam adhibent), sed etiam quoad propositiones medias; quas educit sane atque parturit, utcunque Syllogismus; sed operum steriles et a practica remotas, et plane quoad partem activam scientiarum incompetentes. Quamvis igitur relinquamus Syllogismo et hujusmodi demonstrationibus famosis ac jactatis jurisdictionem in artes populares et opinabiles (nil enim in hac parte movemus); tamen ad Naturam rerum Inductione per omnia, et tam ad minores propositiones quam ad majores, utimur. Inductionem enim censemus eam esse demonstrandi formam, quæ sensum tuetur, et Naturam premit, et operibus imminet ac fere immiscetur.

Itaque ordo quoque demonstrandi plane invertitur. Adhuc

enim res ita geri consuevit, ut a sensu et particularibus primo loco ad maxime generalia advoletur, tanquam ad polos fixos circa quos disputationes vertantur; ab illis cætera per media deriventur: via certe compendiaria sed præcipiti; et ad Naturam impervia, ad disputationes vero proclivi et accommodata. At secundum nos Axiomata continenter et gradatim excitantur, ut non nisi postremo loco ad generalissima veniatur: ea vero generalissima evadunt, non notionalia sed bene terminata, et talia quæ Natura ut revera sibi notiora agnoscat, quæque rebus hæreant in medullis.

At in forma ipsa quoque Inductionis, et judicio quod per eam fit, opus longe maximum movemus. Ea enim de qua Dialectici loquuntur, quæ procedit per enumerationem simplicem, puerile quiddam est, et precario concludit, et periculo ab instantia contradictoria exponitur, et consueta tantum intuetur; nec exitum reperit.

Atqui opus est ad scientias Inductionis forma tali, quæ experientiam solvat et separet, et per exclusiones ac rejectiones debitas necessario concludat. Quod si judicium illud vulgatum Dialecticorum tam operosum fuerit, et tanta ingenia exercuerit; quanto magis laborandum est in hoc altero, quod non tantum ex mentis penetralibus, sed etiam ex Naturæ visceribus extrahitur?

Neque tamen hic finis. Nam fundamenta quoque scientiarum fortius deprimimus et solidamus, atque initia inquirendi altius sumimus, quam adhuc homines fecerunt: ea subjiciendo examini, quæ Logica vulgaris, tanquam fide aliena, recipit. Etenim Dialectici principia scientiarum a scientiis singulis tanquam mutuo sumunt; rursus notiones mentis primas venerantur; postremo informationibus immediatis sensus bene dispositi acquiescunt. At nos Logicam veram singulas scientiarum provincias, majore cum imperio quam penes ipsarum principia sit, debere ingredi decrevimus; atque illa ipsa principia putativa ad rationes reddendas compellere, quousque plane constent. Quod vero attinet ad notiones primas intellectus; nihil

est eorum, quæ intellectus sibi permissus congessit, quin nobis pro suspecto sit, nec ullo modo ratum, nisi novo judicio se stiterit, et secundum illud pronunciatum fuerit. Quin etiam sensus ipsius informationes multis modis excutimus. Sensus enim fallunt utique; sed et errores suos indicant; verum errores præsto, indicia eorum longe petita sunt.

Duplex autem est Sensus culpa; aut enim destituit nos, aut decipit. Nam primo, plurimæ sunt res quæ sensum etiam recte dispositum, nec ullo modo impeditum, effugiunt; aut subtilitate totius corporis, aut partium minutiis, aut loci distantia, aut tarditate atque etiam velocitate motus, aut familiaritate objecti, aut alias ob causas. Neque rursus, ubi Sensus rem tenet, pretensiones ejus admodum firmæ sunt. Nam testimonium et informatio Sensus semper est ex analogia hominis, non ex analogia universi: atque magno prorsus errore asseritur, Sensum esse mensuram rerum.

Itaque ut his occurratur; nos multo et fido ministerio auxilia Sensus undique conquisivimus et contraximus; ut destitutionibus substitutiones, variationibus rectificationes suppeditentur. Neque id molimur tam instrumentis quam experimentis. Etenim experimentorum longe major est subtilitas, quam Sensus ipsius, licet instrumentis exquisitis adjuti; (de iis loquimur experimentis, quæ ad intentionem ejus quod quæritur perite et secundum artem excogitata et apposita sunt). Itaque perceptioni sensus immediatæ ac propriæ non multum tribuimus; sed eo rem deducimus, ut sensus tantum de experimento, experimentum de re judicet. Quare existimamus nos sensus (a quo omnia in naturalibus petenda sunt, nisi forte libeat insanire) Antistites religiosos, et oraculorum ejus non imperitos Interpretes nos præstitisse; ut alii professione quadam, nos reipsa Sensum tueri ac colere videamur. Atque hujusmodi sunt ea, quæ ad lumen ipsum Naturæ ejusque accensionem et immissionem paramus: quæ per se sufficere possent, si intellectus humanus æquus et instar tabulæ abrasæ esset. Sed cum mentes hominum miris modis adeo obsessæ sint, ut ad veros rerum

radios excipiendos sincera et polita area prorsus desit; necessitas quædam incumbit, ut etiam huic rei remedium quærendum esse putemus.

Idola autem, a quibus occupatur Mens, vel adscititia sunt, vel innata. Adscititia vero immigrarunt in mentes hominum, vel ex Philosophorum placitis et sectis, vel ex perversis legibus demonstrationum. At innata inhærent naturæ ipsius intellectus, qui ad errorem longe proclivior esse deprehenditur, quam sensus. Utcunque enim homines sibi placeant, et in admirationem mentis humanæ ac fere adorationem ruant, illud certissimum est—sicut speculum inæquale rerum radios ex figura et sectione propria immutat, ita et mentem, cum a rebus per sensum patitur, in notionibus suis expediendis et comminiscendis haud optima fide rerum naturæ suum naturam inserere et immiscere.

Atque priora illa duo *Idolorum* genera ægre, postrema vero hæc nullo modo evelli possunt. Id tantum relinquitur, ut indicentur; atque ut vis ista mentis insidiatrix notetur et convincatur, ne forte a destructione veterum novi subinde errorum surculi ex ipsa mala complexione mentis pullulent; coque res recidat, ut errores non extinguantur, sed permutentur: verum e contra, ut illud tandem in æternum ratum et fixum sit, Intellectum nisi per Inductionem, ejusque formam legitimam, judicare non posse. Itaque doctrina ista de expurgatione intellectus, ut ipse ad veritatem habilis sit, tribus redargutionibus absolvitur: redargutione Philosophiarum, redargutione Demonstrationum, et redargutione Rationis humanæ nativæ. His vero explicatis, ac postquam demum patuerit, quid rerum natura, quid mentis natura ferat; existimamus nos thalamum Mentis et Universi, pronuba divina bonitate, stravisse et ornasse. Epithalamii autem votum sit, ut ex eo connubio auxilia humana, et stirps inventorum, quæ necessitates ac miserias hominum aliqua ex parte doment et subigant, suscipiatur.

Hæc vero est Operis pars secunda.

SERENISSIMO

SERENISSIMO POTENTISSIMOQUE PRINCIPI
AC DOMINO NOSTRO,

JACOBO,

DEI GRATIA MAGNÆ BRITANNIÆ, FRANCIÆ, ET
HIBERNIÆ REGI, FIDEI DEFENSORI, &c.

Serenissime Potentissimeque Rex,

POTERIT fortasse Majestas tua me furti incusare, quod tantum temporis, quantum ad hæc sufficiat, negotiis tuis suffuratus sim. Non habeo quod dicam. Temporis enim non fit restitutio; nisi forte quod detractum fuerit temporis rebus tuis, id memoriæ nominis tui, et honori sæculi tui reponi possit; si modo hæc alicujus sint pretii. Sunt certe prorsus nova; etiam toto genere: sed descripta ex veteri admodum exemplari, mundo scilicet ipso, et natura rerum et mentis. Ipse certe (ut ingenue fatear) soleo æstimare hoc opus magis pro partu temporis, quam ingenii. Illud enim in eo solummodo mirabile est; initia rei, et tantas de iis quæ invaluerunt suspiciones, alicui in mentem venire potuisse. Cætera non illibenter sequuntur. At versatur proculdubio casus (ut loquimur) et quiddam quasi fortuitum, non minus in iis quæ cogitant homines, quam in iis quæ agunt aut loquuntur. Verum hunc casum (de quo loquor) ita intelligi volo, ut si quid in his, quæ affero, sit boni, id immensæ misericordiæ et bonitati divinæ, et felicitati temporum tuorum tribuatur: cui et vivus integerrimo affectu servivi, et mortuus fortasse id effecero, ut illa posteritati, nova hac accensa face in philosophiæ tenebris, prælucere possint. Merito autem temporibus regis omnium sapientissimi et

doctissimi *regeneratio* ista et *instauratio* scientiarum debetur. Superest petitio, majestate tua non indigna; et maxime omnium faciens ad id quod agitur. Ea est, ut, quando Salomonem in plurimis referas, judiciorum gravitate, regno pacifico, cordis latitudine, librorum denique, quos composuisti, nobili varietate: etiam hoc ad ejusdem regis exemplum addas, ut cures historiam naturalem et experimentalem, veram et severam, (missis philologicis) et quæ sit in ordine ad condendam philosophiam, denique qualem suo loco describemus, congeri et perfici: ut tandem post tot mundi ætates philosophiæ et scientiæ non sint amplius pensiles et aëreæ, sed solidis experientiæ omnigenæ, ejusdemque bene pensitatæ, nitantur fundamentis. Equidem *Organum* præbui; verum materies a rebus ipsis petenda est. Deus Optimus Maximus Majestatem tuam diu servet incolumem.

Serenissimæ Majestati Tuæ

Servus devinctissimus et devotissimus,

FRANCISCUS VERULAM,

CANCELLARIUS.

NOVUM ORGANUM,

SIVE

INDICIA[1] VERA DE INTERPRETATIONE NATURÆ.

PRÆFATIO.

QUI[2] de natura, tanquam de re explorata, pronuntiare ausi sunt, sive hoc ex animi fiducia fecerint, sive ambitiose et more professorio; maximis illi philosophiam et scientias detrimentis affecere. Ut enim ad fidem faciendam validi, ita enim ad inquisitionem extinguendam et abrumpendam efficaces fuerunt: neque virtute propria tantum profuerunt, quantum in hoc nocuerunt, quod aliorum virtutem corruperint et perdiderint. Qui autem contrariam huic viam ingressi sunt, atque nihil prorsus sciri posse asseruerunt, sive ex sophistarum veterum odio, sive ex animi fluctuatione, aut etiam ex quadam doctrinæ copia, in hanc opinionem delapsi sint, certe non contemnendas ejus rationes adduxerunt: veruntamen nec a veris initiis sententiam suam derivarunt, et, studio quodam atque

[1] *Indicia*—not "Suggestions" or "Indications," as it has been usually translated, but rather in the sense of "Delatio rei occultæ," "Information." I have ventured to use the concrete for the abstract, and have rendered it "Guide."

[2] The Dogmatists: for whom see Bk. I. Aph. 67. The other class, opposed to them, is that of the "Sceptics."

affectatione provecti, prorsus modum excesserunt. At antiquiores ex Græcis[3] (quorum scripta perierunt) inter pronuntiandi jactantiam et *acatalepsiæ* desperationem prudentius se sustinuerunt: atque de inquisitionis difficultate, et rerum obscuritate, sæpius querimonias et indignationes miscentes, et veluti frænum mordentes, tamen propositum urgere, atque naturæ se immiscere non destiterunt: consentaneum (ut videtur) existimantes, hoc ipsum (videlicet utrum aliquid sciri possit) non disputare, sed experiri: et tamen illi ipsi, impetu tantum intellectus usi, regulam non adhibuerunt, sed omnia in acri meditatione et mentis volutatione et agitatione perpetua posuerunt.

Nostra autem ratio, ut opere ardua, ita dictu facilis est. Ea enim est, ut certitudinis gradus constituamus, sensum per reductionem quandam tueamur[4], sed mentis opus, quod sensum subsequitur, plerumque rejiciamus[5]; novam autem et certam viam, ab ipsis sensuum perceptionibus, menti aperiamus et muniamus. Atque hoc proculdubio viderunt et illi, qui tantas dialecticæ

[3] Cf. I. Aph. 71, 89. and De Augm. Sc. III. 4.

[4] Shaw explains this difficulty thus: "By contriving ways of transmitting things in a proper manner to the senses, that a true judgment may be formed of them when thus again brought under view." It seems simply to mean "strengthening and defending the authority of the senses by keeping them within their proper limits;" as Bacon says (I. 126.) "sensui non derogamus sed ministramus." It will be best explained, perhaps, by reference to that part of the "Distributio operis," which refers to the Nov. Org. where he says, "Perceptioni sensus immediatæ ac propriæ non multum tribuimus: sed eo rem deducimus, ut sensus tantum de experimento, experimentum de re judicet. Quare existimamus nos sensus Antistites religiosos, et oraculorum ejus non imperitos Interpretes nos præstitisse: ut alii professione quadam, nos reipsa sensum *tueri* ac colere videamur."

[5] Rejecting those hasty conclusions to which the Intellect left to itself will leap immediately after sensible appreciation. Here again the Distributio throws light on the meaning "Quod vero attinet ad notiones primas intellectus; nihil est eorum, quæ intellectus sibi permissus congessit, quin nobis pro suspecto sit, nec ullo modo ratum, nisi novo judicio se stiterit, et secundum illud pronunciatum fuerit."

partes tribuerunt. Ex quo liquet, illos intellectui adminicula quæsivisse, mentis autem processum nativum et sponte moventem suspectum habuisse. Sed serum plane rebus perditis hoc adhibetur remedium; postquam mens, ex quotidiana vitæ consuetudine, et auditionibus et doctrinis inquinatis occupata, et vanissimis *idolis* obsessa fuerit. Itaque ars illa dialecticæ, sero (ut diximus) cavens, neque rem ullo modo restituens, ad errores potius figendos quam ad veritatem aperiendam valuit. Restat unica salus ac sanitas, ut opus mentis universum de integro resumatur; ac mens jam ab ipso principio nullo modo sibi permittatur, sed perpetuo regatur; ac res, veluti per machinas, conficiatur. Sane si homines opera mechanica nudis manibus, absque instrumentorum vi et ope, aggressi essent, quemadmodum opera intellectualia nudis fere mentis viribus tractare non dubitarunt; parvæ admodum fuissent res, quas movere et vincere potuissent, licet operas enixas, atque etiam conjunctas præstitissent. Atque si paulisper morari, atque in hoc ipsum exemplum, veluti in speculum, intueri velimus; exquiramus (si placet) si forte obeliscus aliquis, magnitudine insignis, ad triumphi vel hujusmodi magnificentiæ decus transferendus esset, atque id homines nudis manibus aggrederentur, annon hoc magnæ cujusdam esse dementiæ spectator quispiam rei sobrius fateretur? Quod si numerum augerent operariorum, atque hoc modo se valere posse confiderent, annon tanto magis? Sin autem delectum quendam adhibere vellent, atque imbecilliores separare, et robustis tantum et vigentibus uti, atque hinc saltem se voti compotes fore sperarent, annon adhuc eos impensius delirare diceret? Quin etiam si, hoc ipso non contenti, artem tandem athleticam consulere statuerent, ac omnes deinceps manibus

et lacertis et nervis ex arte bene unctis et medicatis adesse juberent, annon prorsus eos dare operam, ut cum ratione quadam et prudentia insanirent, clamaret? Atque homines tamen simili malesano impetu, et conspiratione inutili, feruntur in intellectualibus; dum ab ingeniorum vel multitudine et consensu, vel excellentia et acumine, magna sperant; aut etiam dialectica (quæ quædam athletica censeri possit) mentis nervos roborant: sed interim, licet tanto studio et conatu, (si quis vere judicaverit) intellectum nudum applicare non desinunt. Manifestissimum autem est in omni opere magno, quod manus hominis præstat, sine instrumentis et machinis vires nec singulorum intendi, nec omnium coire posse.

Itaque ex his quæ diximus præmissis, statuimus duas esse res, de quibus homines plane monitos volumus, ne forte illæ eos fugiant aut prætereant. Quarum prima hujusmodi est; fieri fato quodam (ut existimamus) bono, ad extinguendas et depellendas contradictiones et tumores animorum, ut et veteribus honor et reverentia intacta et imminuta maneant[6], et nos destinata perficere, et tamen modestiæ nostræ fructum percipere possimus. Nam nos, si profiteamur nos meliora afferre quam antiqui, eandem quam illi viam ingressi, nulla verborum arte efficere possimus, quin inducatur quædam ingenii, vel excellentiæ, vel facultatis comparatio sive contentio: non ea quidem illicita aut nova; (quidni enim possimus, pro jure nostro, neque eo ipso alio quam omnium, si quid apud eos non recte inventum aut positum sit, reprehendere aut notare?) sed tamen utcunque justa aut permissa; nihilominus impar fortasse fuisset ea ipsa contentio, ob virium nostrarum modum. Verum quum per nos illud agatur, ut alia

[6] Cf. I. 32. 35.

omnino via intellectui aperiatur illis intentata et incognita, commutata jam ratio est; cessant studium et partes; nosque indicis tantummodo personam sustinemus; quod mediocris certe est auctoritatis, et fortunæ cujusdam potius, quam facultatis et excellentiæ. Atque hæc moniti species ad personas pertinet, altera ad res ipsas.

Nos siquidem de deturbanda ea, quæ nunc floret, philosophia, aut si quæ alia sit, aut erit, hac emendatior aut auctior, minime laboramus. Neque enim officimus, quin philosophia ista recepta, et aliæ id genus, disputationes alant, sermones ornent, ad professoria munera et vitæ civilis compendia, adhibeantur et valeant. Quin etiam aperte significamus et declaramus eam, quam nos adducimus, philosophiam ad istas res admodum utilem non futuram. Non præsto est; neque in transitu capitur; neque ex prænotionibus intellectui blanditur; neque ad vulgi captum, nisi per utilitatem et effecta, descendet.

Sint itaque (quod felix faustumque sit utrique parti) duæ doctrinarum emanationes, ac duæ dispensationes; duæ similiter contemplantium sive philosophantium tribus, ac veluti cognationes; atque illæ neutiquam inter se inimicæ aut alienæ, sed fœderatæ et mutuis auxiliis devinctæ: sit denique alia scientias colendi, alia inveniendi ratio. Atque quibus prima potior et acceptior est, ob festinationem, vel vitæ civilis rationes, vel quod illam alteram ob mentis infirmitatem capere et complecti non possint, (id quod longe plurimis accidere necesse est) optamus, ut iis feliciter et ex voto succedat quod agunt, atque ut quod sequuntur teneant. Quod si cui mortalium cordi et curæ sit, non tantum inventis hærere, atque iis uti, sed ad ulteriora penetrare; atque non disputando adversarium, sed opere

naturam vincere; denique, non belle et probabiliter opinari, sed certo et ostensive scire; tales, tanquam veri scientiarum filii, nobis (si videbitur) se adjungant; ut omissis naturæ atriis, quæ infiniti contriverunt, aditus aliquando ad interiora patefiat. Atque ut melius intelligamur, utque illud ipsum, quod volumus, ex nominibus impositis magis familiariter occurrat; altera ratio, sive via, *anticipatio mentis*[7]; altera, *interpretatio naturæ*, a nobis appellari consuevit.

Est etiam quod petendum videtur. Nos certe cogitationem suscepimus, et curam adhibuimus, ut quæ a nobis proponentur, non tantum vera essent, sed etiam ad animos hominum (licet miris modis occupatos et interclusos) non incommode aut aspere accederent. Veruntamen æquum est, ut ab hominibus impetremus, (in tanta præsertim doctrinarum et scientiarum restauratione) ut qui de hisce nostris aliquid, sive ex sensu proprio, sive ex auctoritatum turba, sive ex demonstrationum formis, (quæ nunc tanquam leges quædam judiciales invaluerunt) statuere aut existimare velit; ne id in transitu, et velut aliud agendo, facere se posse speret: sed ut rem pernoscat; nostram, quam describimus et munimus, viam ipse paulatim tentet; subtilitati rerum, quæ in experientia signata est, assuescat; pravos denique, atque alte hærentes mentis habitus, tempestiva et quasi legitima mora corrigat; atque tum demum, (si placuerit) postquam in potestate sua esse cœperit, judicio suo utatur.

[7] Cf. I. 26—36.

APHORISMI[1]

DE

INTERPRETATIONE NATURÆ,

ET

REGNO HOMINIS.

APHORISMUS I.

HOMO[2], naturæ minister et interpres, tantum facit et

[1] "Aphorismi." See Adv. of Learning, Bk. ii. "Aphorisms, except they be ridiculous, cannot be made but of the pith and heart of Science; for discourse of illustration is cut off; discourse of connection and order is cut off; descriptions of practice are cut off; so there remaineth nothing to fill the Aphorism but some good quantity of observation." Again, Nov. Org. I. 86. "Aphorismi—sive breves, eædemque sparsæ nec methodo revinctæ sententiæ." How strangely Bacon ignores his own description of Aphorisms! For many of those in the Nov. Org. are long chapters full of "Illustration, example, and connection," and any thing but terse pithy sayings.

[2] This Aphorism occurs at the end of the "Distributio Operis" with the following addition: "Neque enim ullæ vires causarum catenam solvere aut perfringere possint: neque Natura aliter quam parendo vincitur:" i. e. Man is but Nature's Interpreter and Servant, not her Master. Effects follow from their Causes; we cannot interrupt the connection, we can only *interpret* (i. e. explain the fact) and *serve*, (i. e. apply or remove the antecedent, and so help or hinder the production of the consequent.) We cannot break God's rule for things, without the supernatural exertion of His Power. "The power of Man over Nature," says Sir J. Herschel in his Discourse on Natural Philosophy, "is limited only by one condition—that it must be exercised in conformity with the Laws of Nature." Any thing beyond this is a Miracle, and this constitutes the true distinction between Miracles

intelligit quantum de naturæ ordine re vel mente[3] observaverit: nec amplius scit, aut potest.

II.

Nec manus nuda, nec intellectus sibi permissus, multum valet[4]; instrumentis et auxiliis res perficitur; quibus opus est, non minus ad intellectum, quam ad manum. Atque ut instrumenta manus motum aut cient aut regunt; ita et instrumenta mentis intellectui aut suggerunt aut cavent.

and ordinary acts of Power. Cf. Mill's Logic, chap. xxv. § 2. Trench on Miracles, chap. ii. As to the *limits* of Man's knowledge, we seem now to be mostly agreed to take the humbler view which denies that we ever can really attain to the knowledge of causes. For what Bacon himself thought as to this, we must refer to II. 1—20. Dugald Stewart, who states the case for Man's limited knowledge most definitely and with most authority, says, "In calling Man 'Naturæ Interpres' Bacon had plainly the same idea of the object of Physics which I attempted to convey when I said that what are commonly called the *causes* of Phenomena are only their established *antecedents* or *signs*." He has also gone into the subject fully in his Philosophy of the Human Mind, ch. i. sect. 2, and note C (upon the same chapter and section). The best Commentary on these first Aphorisms is the opening of Bk. ii, where these are expanded and illustrated. They contain the object of the whole work: "veritas et utilitas" (I. 124) are his aim—correct and increased knowledge, and an expanded field for practice. Cf. also Hallam Lit. of Eur. Part iii. ch. III. § 62.

[3] For "re" the "Distributio" reads "opera," shewing that the distinction is between our observation of things, facts, effects in the Universe, and our mental operations on them: "re" by observation, "mente" by contemplation. This Aph. has been usually spoiled in translations. Hallam has given it correctly, Lit. Eur. *ubi supra*.

[4] This feebleness, arising from want of instrumental aids, is treated of more at length in the Preface. In fact these first few Aphorisms pass over much the same ground. The objects of all Instruments are twofold, positive and negative, to incite, or to regulate. The 1st Book of the Nov. Org. being the "Pars operis destruens" is almost entirely regulative, points out errors, and removes them; "Intellectui cavet." The 2nd Book is constructive; "Intellectui suggerit." An analogous Organon, Bacon holds, (I. 127), might be applied to other subjects, and so in Morals our Apparatus (Education, Law, &c.) are properly intended to regulate the Appetites and Feelings, and to stimulate the Intellectual part of man. So too in Politics. For the way in which Bacon regards the Nov. Org. as instrumental, cf. I. 127. II. 52.

III.

Scientia et potentia humana in idem coincidunt [5], quia ignoratio causæ destituit effectum. Natura enim non nisi parendo vincitur [6]: et quod in contemplatione instar causæ est, id in operatione instar regulæ est.

IV.

Ad opera nil aliud potest homo, quam ut corpora naturalia admoveat et amoveat: reliqua natura intus transigit [7].

V. [8]

Solent se immiscere naturæ (quoad opera) mechani-

[5] "In idem coincidunt" as far as man's intentional production is concerned. For this union of man's knowledge and power, cf. II. 3. "Ex formarum inventione sequitur contemplatio vera, et operatio libera." And we have an example of it in the Definition of Heat in the "First Vintage," II. 20.

[6] Cf. I. 129. "The powers which act in the processes of Nature and in those of Art are precisely the same, and are only directed in the latter case by the intention of man towards particular objects." Playfair, Diss. iii. in the Preliminary Vol. Encycl. Brit. p. 459.

[7] Cf. de Augm. Sc. II. 2. "This certain truth should be thoroughly settled in the minds of men, that artificials differ not from natural in form and essence, but in the efficient only: for man hath no power over Nature save only in her motion; i. e. to mingle or put together natural bodies, and to separate or put them asunder: wherefore where there is apposition and separation of bodies natural, conjoining (as they term it) active with passive, man may do all things: this not done, he can do nothing." And Playfair (ubi supr.) "In Art, man does nothing more than bring things nearer to one another, or carry them farther off; the rest is performed by Nature, and on most occasions by means of which we are quite ignorant."

[8] As to the Mechanician, the Mathematician and the Physician, Bacon's remarks were being falsified at the very time he wrote.—Mechanics had produced fly-clocks, telescopes, and other useful contrivances.—Mathematics boasted of Kepler and Galileo; and the discoveries of Harvey and Gilbert were opening out a new world for Medical research. But Bacon could scarcely have discerned all this, and his jealousy of his contemporaries (cf. I. 54) would scarcely have allowed him to acknowledge their worth. Besides this he was utterly ignorant of Mathematics (see Hallam Lit. Eur. vol. II. iii. 3. § 78). Alchemy was certainly thoroughly empirical and faulty; for "at this time Chemistry seemed to have an elective attraction for everything that was absurd and unfounded." (Playfair.) And Magic, which still exerted great influence, was as bad. Sir T. Browne

cus, mathematicus, medicus, alchemista, et magus; sed omnes (ut nunc sunt res) conatu levi, successu tenui.

VI.

Insanum quiddam esset, et in se contrarium, existimare ea, quæ adhuc nunquam facta sunt, fieri posse, nisi per modos adhuc nunquam tentatos.

VII.

Generationes mentis et manus numerosæ admodum videntur in libris et opificiis. Sed omnis ista varietas sita est in subtilitate eximia, et derivationibus paucarum rerum, quæ innotuerunt; non in numero axiomatum [9].

VIII.

Etiam opera, quæ jam inventa sunt, casui debentur et experientiæ, magis quam scientiis [10]: scientiæ enim, quas nunc habemus, nihil aliud sunt quam quædam

Rel. Med. i. 31. gives some account of it; which is worth consulting as it gives the views of a Physician and contemporary of Bacon. Cf. also De Augm. Sc. iii. 5. and Adv. of Learning Bk. ii. Mechanics, Alchemy and Magic, are treated of more at length infra I. 85. Bacon's remarks are however true enough of the ordinary state of these subjects in his day.

[9] Cf. Adv. of Learning, Bk. i. on Contentious Learning, also infr. I. 85. 106. There is a tendency here too (which runs throughout Bacon's writings) to underrate. Maurice says of him that "one of his chief faults was his failing in the reverence due to his great predecessors;" and this will appear more as we go on. Here he seems to ignore the growth of the Fine Arts, Architecture and Painting especially. But these he may possibly have passed by intentionally as having little to do (though could this be true?) with that "Truth and Utility" he was aiming at. It is remarkable that in Aph. 85 he takes no notice of the Fine Arts, even under the head of "Artes Liberales." But then, one might say, what else was to be expected from one who (De Augm. iv.) can class Painting and Music among low "Artes Voluptuariæ." See Hallam Lit. Eur. II. iii. i. § 48.

For the term Axiom see Appendix A.

[10] This was in Bacon's day for the most part true of Physics, though not at all so of either Mathematics or the Fine Arts. And Bacon professes here to be treating (it is presumed) of the whole circle of Human Knowledge.

For *τύχη* and *ἐμπειρία* and their difference from and connection with *ἐπιστήμη* see Aristotle Eth. Nic. vi. 4. Metaph. I. 1.

concinnationes rerum antea inventarum; non modi inveniendi, aut designationes novorum operum.

IX.

Causa vero et radix fere omnium malorum in scientiis ea una est; quod dum mentis humanæ vires falso miramur et extollimus, vera ejus auxilia non quæramus.

X.

Subtilitas naturæ subtilitatem sensus et intellectus multis partibus superat[11]; ut pulchræ illæ meditationes et speculationes humanæ et causationes, res malesana sint, nisi quod non adsit qui advertat.

XI.

Sicut scientiæ, quæ nunc habentur, inutiles sunt ad inventionem operum; ita et logica, quæ nunc habetur, inutilis est ad inventionem scientiarum[12].

XII.

Logica, quæ in usu est, ad errores (qui in notionibus vulgaribus fundantur) stabiliendos et figendos valet, potius quam ad inquisitionem veritatis; ut magis damnosa sit, quam utilis[13].

XIII.

Syllogismus ad principia scientiarum non adhibetur, ad media axiomata frustra adhibetur, cum sit subtilitati

[11] This subtilty of Nature Bacon seemed to think would be laid bare by the investigation of *Latent Process* and *Structure* and by the discovery of Forms, in Bk. II. His language is very like that of Aristotle here, and in several other places. See Arist. Metaph. Bk. A the less. i. *Ἴσως δὲ καὶ τῆς χαλεπότητος οὔσης κατὰ δύο τρόπους, οὐκ ἐν τοῖς πράγμασιν, ἀλλ' ἐν ἡμῖν τὸ αἴτιον αὐτῆς. Ὥσπερ γὰρ καὶ τὰ τῶν νυκτερίδων ὄμματα πρὸς τὸ φέγγος ἔχει τὸ μεθ' ἡμέραν, οὕτω καὶ τῆς ἡμετέρας ψυχῆς ὁ νοῦς πρὸς τὰ τῇ φύσει φανερώτατα πάντων.*

[12] For the old system of Logic see Appendix B. Cf. II. 52, and that part of the "Distributio" which is prefixed to this edition, and refers to the Nov. Org.

[13] What is wanted is not power of drawing Inferences from given Principles, but of discovering Principles themselves.

naturæ longe impar. Assensum itaque constringit, non res.

XIV.

Syllogismus ex propositionibus constat, propositiones ex verbis, verba notionum tesseræ sunt[14]. Itaque si notiones ipsæ (id quod basis rei est) confusæ sint, et temere a rebus abstractæ; nihil in iis, quæ superstruuntur, est firmitudinis. Itaque spes est una in *inductione* vera[15].

XV.

In notionibus nil sani est, nec in logicis, nec in physicis: non *substantia*, non *qualitas*, *agere*, *pati*, ipsum *esse*, bonæ notiones sunt; multo minus *grave*, *leve*, *densum*, *tenue*, *humidum*, *siccum*, *generatio*, *corruptio*, *attrahere*, *fugare*, *elementum*, *materia*, *forma*, et id genus; sed omnes phantasticæ et male terminatæ.

XVI.

Notiones infimarum specierum, *hominis*, *canis*, *columbæ*, et prehensionum immediatarum sensus, *calidi*, *frigidi*, *albi*, *nigri*, non fallunt magnopere; quæ tamen ipsæ a fluxu materiæ et commissione rerum quandoque confunduntur; reliquæ omnes (quibus homines hactenus usi sunt) aberrationes sunt, nec debitis modis a rebus abstractæ et excitatæ.

[14] Words are symbols of conceptions, and how far do they react upon men's minds, and become the causes of conceptions? If our conceptions be definite and wrong, the syllogism only leads us the farther astray; if indefinite and vague, the syllogism falls under M. Turgot's censure (Œuvres, tom. iii. p. 68, quoted by Stewart on the Human Mind, vol. II. ch. iii. § 2): Tout l'artifice de ce calcul ingénieux, dont Aristote nous a donné les règles, tout l'art du syllogisme est fondé sur l'usage des mots dans le même sens; l'emploi d'un même mot dans deux sens différens fait de tout raisonnement un sophisme; et ce genre de sophisme, peut-être le plus commun de tous, est une des sources les plus ordinaires de nos erreurs." But they who write of the syllogism by and in itself of course ought to cut off all connection between it and matter. But for all this see Appendix B.

[15] First mention of *Induction*. Treated of fully in I. 104. 105.

XVII.

Nec minor est libido et aberratio in constituendis axiomatibus, quam in notionibus abstrahendis; idque in ipsis principiis, quæ ab inductione vulgari pendent. At multo major est in axiomatibus, et propositionibus inferioribus, quæ educit syllogismus.

XVIII.

Quæ adhuc inventa sunt in scientiis, ea hujusmodi sunt, ut notionibus vulgaribus fere subjaceant: ut vero ad interiora et remotiora naturæ penetretur, necesse est ut tam notiones quam axiomata magis certa et munita via a rebus abstrahantur, atque omnino melior et certior intellectus adoperatio in usum veniat.

XIX.

Duæ viæ sunt, atque esse possunt, ad inquirendam et inveniendam veritatem. Altera a sensu et particularibus advolat ad axiomata maxime generalia, atque ex iis principiis eorumque immota veritate judicat et invenit axiomata media; atque hæc via in usu est[16]. Altera a sensu et particularibus excitat axiomata, ascendendo continenter et gradatim, ut ultimo loco perveniatur ad maxime generalia; quæ via vera est, sed intentata.

XX.

Eandem ingreditur viam (priorem scilicet) intellectus sibi permissus, quam facit ex ordine dialecticæ. Gestit enim mens exsilire ad magis generalia, ut acquiescat[17];

[16] Cf. I. 22. and 104. The contrast between the two is drawn out in the latter of these Aphorisms.

[17] "ut acquiescat." This yearning after an ἐπιστήμη, a something definite and conclusive in which to rest, a shrinking from the indefinite, and prayer for a *rule*, may be counted as one of the Instincts of Human Nature. It shews itself in Morals, Politics, Religion, as much as in other subjects. It arises in great part from our fear of our own Responsibility, and of the duty of judging for ourselves. It leads in Physics to hasty dogmatic generali-

et post parvam moram fastidit experientiam: sed hæc mala demum aucta sunt a dialectica ob pompas disputationum[18].

XXI.

Intellectus sibi permissus, in ingenio sobrio et patiente et gravi, (præsertim si a doctrinis receptis non impediatur,) tentat nonnihil illam alteram viam, quæ recta est, sed exiguo profectu; cum intellectus, nisi regatur et juvetur, res inæqualis sit, et omnino inhabilis ad superandam rerum obscuritatem.

XXII.

Utraque via orditur a sensu et particularibus, et acquiescit in maxime generalibus: sed immensum quiddam discrepant; cum altera perstringat tantum experientiam et particularia cursim; altera in iis rite et ordine versetur: altera rursus jam a principio constituat generalia quædam abstracta et inutilia; altera gradatim exsurgat ad ea quæ revera naturæ sunt notiora[19].

XXIII.

Non leve quiddam interest inter humanæ mentis *idola*[20], et divinæ mentis ideas[21]; hoc est, inter placita

zations, such as those of the Neptunian and Vulcanian theories in the earlier History of Geology. The weariness of suspended judgment—being too the weariness of thought—leads us into grave errors. Nothing so much shews that Man's real good does *not* lie in *θεωρία*, but in the moral world of actions and feelings.

18 "Pompæ disputationum." Scholastic and formal Discussions upon given Theses, relics of which still survive.

19 "Naturæ notiora." Aristotle's *φύσει (ἁπλῶς) γνωριμώτερα*. Cf. the part of the "Distributio" given above: "quæ rebus hæreant in medullis." These will be the "divinæ mentis ideæ" of the next Aphorism, which seem also to be the *Forms*, of which we shall hear much presently.

20 Idola. Εἴδωλα, phantoms or spectres, not "idols" in our sense: "images" as bearing both senses perhaps comes near the meaning. Hallam, Lit. of Europe, Part III, Chap. iii. § 60, attacks the translation *Idols*, which Playfair had sanctioned in the Dissert. (Encycl. Brit. p. 455.) "the false divinities to which the mind had so long been accustomed to bow." In the Advancement of

quædam inania, et veras signaturas atque impressiones factas in creaturis, prout inveniuntur.

XXIV.

Nullo modo fieri potest, ut axiomata per argumentationem[22] constituta ad inventionem novorum operum valeant; quia subtilitas naturæ subtilitatem argumentandi multis partibus superat. Sed axiomata, a particularibus rite et ordine abstracta, nova particularia rursus facile indicant et designant; itaque scientias reddunt activas.

XXV.

Axiomata, quæ in usu sunt, ex tenui et manipulari experientia[23], et paucis particularibus, quæ ut pluri-

Learning Bacon himself calls them (Pickering's ed. p. 193. 195) "Fallacies" or "False Appearances." From his love for pregnant words, we might have thought, but for his own English terms, that he meant "false Gods;" but it seems pretty clear that he means Phantoms, especially as he refers to Plato's cave in the Advancement, where the captives saw only shadows, and heard but the echo of voices. The English word *Idol* once bore the sense of εἴδωλον; but as it does not now, and as there is nothing to shew that the notion of False Gods was in Bacon's mind, it will be best to translate "Phantoms" or "Appearances."

21 "Divinæ mentis ideæ." This language is directly borrowed from Plato. But that Bacon did not mean what Plato is ordinarily supposed to mean by his ἰδέαι is clear from the whole account of *Form* in Bk. II. and especially from II. 17. "non intelligantur ea, quæ dicimus, de Formis et Ideis abstractis, ut in materia non determinatis, aut male determinatis." He evidently here alludes to Aristotle's distinction between εἴδη χωριστὰ and ἀχώριστα (Met. xii. 4), and holds that as God is Author of the Universe He has made all things according to the "Patterns in the Divine Mind," (whatsoever may be hidden under the phrase:) but that it would be futile for Man to endeavour to contemplate any thing abstracted from, and out of its connexion with, the material world. It would be premature to discuss the Baconian Form here. It will come up again: cf. I. 66. 75. 124. II. 1—20. De Augm. Sc. V. 4. Adv. of Learning, p. 55, 139 (Pickering's ed.) See also D. Stewart, Philosophy of the Human Mind, ch. iv. § 6.

22 By controversy only, without appeal to facts. The Schoolmen substituted their universe of conceptions for that of things; but made little progress in real knowledge. The subtilty of even the Imagination is far below the subtilty of facts. Cf. I. 10.

23 "An experience scanty and in

mum occurrunt, fluxere; et sunt fere ad mensuram eorum facta et extensa: ut nil mirum sit, si ad nova particularia non ducant. Quod si forte instantia aliqua, non prius animadversa aut cognita, se offerat, axioma distinctione aliqua frivola salvatur, ubi emendari ipsum verius foret.

XXVI.

Rationem humanam, qua utimur ad naturam, *anticipationes*[24] *naturæ*, (quia res temeraria est et præmatura); at illam rationem quæ debitis modis elicitur a rebus, *interpretationem naturæ*, docendi gratia, vocare consuevimus.

XXVII.

Anticipationes satis firmæ sunt ad consensum; quandoquidem, si homines etiam insanirent ad unum modum et conformiter, illi satis bene inter se congruere possent[25].

XXVIII.

Quin longe validiores sunt ad subeundum assensum *anticipationes*, quam *interpretationes;* quia ex paucis collectæ, iisque maxime quæ familiariter occurrunt, intellectum statim perstringunt[26], et phantasiam implent; ubi contra, *interpretationes*, ex rebus admodum variis et multum distantibus sparsim collectæ, intellectum

handfuls;" or it may refer to the "nuda manus" of I. 2, and to the want of Instrumental aids. These Axioms Bacon says in I. 7. are few in number; eked out by endless subdivisions, distinctions, and applications. Cf. I. 85.

[24] Though perhaps he would not have allowed it, there is a condemnation of the older method in the very name "Anticipationes." And most of Bacon's professions of peacefulness have in them a tinge of Irony.

[25] This would seem to be levelled against the argument from universal consent, which would be used against the new system. Cf. I. 77. Bacon probably alludes to Horace, Serm. II. 3. 40, &c.

[26] Cf. Adv. of Learning, p. 51, where speaking of a parallel evil to this, (viz. that of those who look at all things from the onesided point of view which some favourite study gives them,) Bacon quotes Aristotle with approbation: "Qui respiciunt ad pauca, de facili pronuntiant."

subito percutere non possunt; ut necesse sit eas, quoad opiniones duras et absonas, fere instar mysteriorum fidei videri.

XXIX.

In scientiis, quæ in opinionibus et placitis[27] fundatæ sunt, bonus est usus *anticipationum* et dialecticæ; quando opus est assensum subjugare, non res[28].

XXX.

Non, si omnia omnium ætatum ingenia coierint, et labores contulerint et transmiserint, progressus magnus fieri poterit in scientiis per *anticipationes:* quia errores radicales, et in prima digestione mentis, ab excellentia functionum et remediorum sequentium non curantur.

XXXI.

Frustra magnum expectatur augmentum in scientiis ex superinductione et insitione novorum super vetera; sed instauratio facienda est ab imis fundamentis, nisi libeat perpetuo circumvolvi in orbem, cum exili et quasi contemnendo progressu[29].

XXXII.

Antiquis auctoribus suus constat honos, atque adeo omnibus[30]; quia non ingeniorum aut facultatum indu-

27 "placita," arbitrary views, without foundation except in the mind of him who holds them; the Aristotelian θέσις.

28 This "subjugation of assent" is the part of those who are content to use the "subtilitas Intellectus," without troubling themselves about the "subtilitas rerum."

29 If the system be thoroughly bad, no patching will avail. The more, too, it is used, the farther wrong it will lead; or at any rate, it will, at the best, carry us round and round in a circle, without real progress. Bacon seems here to allude to Matth. ix. 16. "No man putteth a piece of new cloth unto an old garment, &c."

30 Cf. Preface: "non ingeniorum, &c." He declares farther on that the new Method does not exalt but level intellects: cf. Infr. I. 122. Though, for the sake of obtaining a hearing, he is willing there should be two "doctrinarum emanationes" —two systems going on side by side; yet he fully believed that his own must soon put an end to the other, as indeed it has done.

citur comparatio, sed viæ; nosque non judicis, sed indicis[31] personam sustinemus.

XXXIII.

Nullum (dicendum enim est aperte) recte fieri potest judicium nec de via nostra, nec de iis quæ secundum eam inventa sunt, per *anticipationes*, (rationem scilicet quæ in usu est) quia non postulandum est ut ejus rei judicio stetur, quæ ipsa in judicium vocatur.

XXXIV.

Neque etiam tradendi aut explicandi ea, quæ adducimus, facilis est ratio; quia, quæ in se nova sunt, intelligentur tamen ex analogia veterum[32].

XXXV.

Dixit Borgia[33] de expeditione Gallorum in Italiam, eos venisse cum creta in manibus, ut diversoria notarent, non cum armis, ut perrumperent[34]. Itidem et

[31] This use of *index*, "guide," leads one to think the *Indicia* of the title must be "the opening out of a new way."

[32] The ancient system and way of thought would be certainly brought to bear unfavourably on his: therefore he sets to work to oppose this, and at the same time to apologise for the difficulty of this his work: cf. Preface *ad fin*. "Ex analogia veterum:" Man, as he lives in the midst of relations, subject to all the influences of what Butler calls "continuous analogies," can very rarely grasp any truth or principle *absolutely;* he needs illustration and connection to make it intelligible to him.

[33] This Borgia was Alexander VI, and the expedition of the French that under Charles VIII, which overran Italy in five months. A.D. 1494.

[34] Bacon alludes to this in the Adv. of Learning (p. 152): "I like better that entry of Truth which cometh peaceably with chalk to mark up those minds which are capable to lodge and harbour it, than that which cometh with pugnacity and contention." He has also quoted it in the De Augmentis. For he was peculiarly given to repeat his favourite illustrations; and in this his mind seems to have been somewhat like Coleridge's. He was peculiarly free from all disputatious humours, and despised rather than attacked those whose knowledge was cast in a scholastic mould, or whose minds were unfit to receive his doctrines. Macaulay (Essay on Bacon) says, "he never engaged in controversy; nay, we cannot recollect, in all his philosophical works, a single passage of a controversial character." The man whose genius led him so clearly to discern resem-

nostra ratio est; ut doctrina nostra animos idoneos et capaces subintret: confutationum enim nullus est usus, ubi de principiis et ipsis notionibus, atque etiam de formis demonstrationum dissentimus[35].

XXXVI.

Restat vero nobis modus tradendi unus et simplex, ut homines ad ipsa particularia et eorum series et ordines adducamus; et ut illi rursus imperent sibi ad tempus abnegationem notionum, et cum rebus ipsis consuescere incipiant.

XXXVII.

Ratio eorum, qui acatalepsiam[36] tenuerunt, et via nostra, initiis suis quodammodo consentiunt; exitu immensum disjunguntur et opponuntur. Illi enim nihil sciri posse simpliciter asserunt; nos, non multum sciri posse in natura, ea, quæ nunc in usu est, via: verum illi exinde auctoritatem sensus et intellectus destruunt; nos auxilia iisdem excogitamus et subministramus.

XXXVIII.

Idola et notiones falsæ, quæ intellectum humanum jam occuparunt, atque in eo alte hærent, non solum

blances rather than differences (cf. I. 55.) was not fit for a controversialist. He loved to discover relations and connections between things, (of this his often fanciful metaphors and similes are signs,) not to attack others, or to mark off lines of distinction. Cf. infr. Aph. 128.

[35] They who differ on first principles cannot argue—a thing which many forget who dispute without looking into the full depth of their difference from others.

[36] He translates "Acatalepsia" in the Advancement of Learning, by "Incomprehensibleness." But this word (besides its unwieldiness) does not convey the exact sense to our ears. The word occurs in Cic. ad Att. xiii. 19. It would properly be applied to the Academics who denied the possibility of all knowledge (nil sciri posse) rather than to the Sceptics, who, according to Sextus Emp., neither asserted nor denied, but doubted. The word for Scepticism is ἐποχή. The Sceptics did not fall into the snare of "dogmatising unbelief" as the later Academy did: cf. I. 67, where Bacon confounds Pyrrho with the New Academy. And it may be added, that practically people refuse to distinguish between the Academy and the Sceptics, classing both under the latter name.

mentes hominum ita obsident, ut veritati aditus difficilis pateat; sed etiam dato et concesso aditu, illa rursus in ipsa instauratione scientiarum occurrent, et molesta erunt; nisi homines præmoniti adversus ea se, quantum fieri potest, muniant[37].

XXXIX.

Quatuor sunt genera *idolorum*, quæ mentes humanas obsident. Iis (docendi gratia) nomina imposuimus; ut primum genus, *idola tribus;* secundum, *idola specus;* tertium, *idola fori;* quartum, *idola theatri*, vocentur.

XL.

Excitatio notionum et axiomatum per *inductionem* veram est certe proprium remedium ad *idola* arcenda et summovenda; sed tamen indicatio *idolorum* magni est usus. Doctrina enim de *idolis* similiter se habet ad *interpretationem naturæ*, sicut doctrina de sophisticis elenchis ad dialecticam vulgarem[38].

XLI.

Idola[39] *tribus* sunt fundata in ipsa natura humana,

[37] It is worthy of notice that Friar Bacon has pointed out the causes of error as clearly as his illustrious successor and namesake has done, in the Opus Majus, cap. i. "Quattuor vero sunt maxime comprehendenda veritatis offendicula, quæ omnem quemcunque sapientem impediunt: (1) fragilis et indignæ auctoritatis exemplum: (2) consuetudinis diuturnitas (3) vulgi sensus imperitus: (4) propriæ ignorantiæ occultatio cum ostentatione sapientiæ apparentis. Nam ubi hæc dominantur, nulla ratio movet, nullum jus judicat, nulla lex ligat, fas locum non habet; naturæ dictamen perit; facies rerum mutatur, ordo confunditur, vitium prævalet, virtus exstinguitur, falsitas regnat, veritas exsufflatur."

[38] As the Soph. El. attacked certain quibbles, and cleared the way for Dialectics, by getting rid of ambiguities, &c., so this part of the Nov. Org. is intended to clear away certain prejudices and preoccupations of men's minds, so as to make way for the declaration of the true Method.

[39] *Idola.* Reference may be made, for a view of the way in which other writers treat the Phantoms of the mind, to D. Stewart's Philosophy of the Human Mind, part II. ch. iii. sect. 2: see also the Port Royal Logic, chapter on "Des sophismes d'amour-propre, d'interêt, et de passion;" and Sir J. Herschel's Discourse on the Study of Nat. Phil. § 68—73.

atque in ipsa tribu seu gente hominum[40]. Falso enim asseritur, sensum humanum esse mensuram rerum; quin contra, omnes perceptiones, tam sensus quam mentis, sunt ex analogia hominis, non ex analogia universi[41]. Estque intellectus humanus instar speculi inæqualis ad radios rerum, qui suam naturam naturæ rerum immiscet, eamque distorquet et inficit.

XLII.

Idola specus sunt idola hominis individui[42]. Habet enim unusquisque (præter aberrationes naturæ humanæ in genere) specum sive cavernam quandam individuam, quæ lumen naturæ frangit et corrumpit; vel propter naturam cujusque propriam et singularem; vel propter

40 The *Idola Tribus* are "those general prejudices which arise from the infirmity of Human Nature itself." For even the old axiom ὃ πᾶσι δοκεῖ, τοῦτ' εἶναί φαμεν (Ar. Eth. x. 2.) must be taken with limitation. It affords a presumption of truth in all cases; in some (those in which all mankind may fairly be supposed able to judge, as in some Moral questions) it gives a Moral certainty. But still man is in no sense perfect or πάντων μέτρον, and if left to himself generates a multitude of errors. Cf. Adv. of Learning, p. 195 (Pickering).

41 "Ex analogia hominis &c." We are wont to refer all our perceptions to man as their measure; and regard them with relation to him (as people do when they argue much from Final Causes), and not in their relation to the Universe of which they form parts. In this recall of Man from himself to the world, Bacon shews a spirit very unlike that of the "Positive" school, who have claimed him as one of themselves.

42 The *Idola Specus*. Those prejudices which are peculiar to individuals, beside and beyond those common to Human Nature. These are, (1) those which arise from differences of temperament, (2) those due to education, (3) to the pursuit of particular studies, (4) to differences in the temporary condition of each man's mind.

There are some good remarks in D. Stewart's Phil. of the Human Mind, vol. I. Introd. ii. § 1. on those "Idola" which are connected with Education, cf. also the De Augm. Sc. V. 4.

The name *Specus* was suggested by Plato's Cave, as we see by reference to the Advancement of Learning, p. 194, where Bacon speaks of "that feigned supposition that Plato maketh of the Cave." (Plato, Rep. vii. 1.) But the parallel does not by any means hold throughout. The Cave of Plato contains all men who do not attain to the knowledge of Ideal Truths; and would in fact include all the "Idola." Bacon calls these "Idola Specus;" else-

educationem et conversationem cum aliis; vel propter lectionem librorum, et auctoritates eorum quos quisque colit et miratur; vel propter differentias impressionum, prout occurrunt in animo præoccupato et prædisposito, aut in animo æquo et sedato, vel ejusmodi: ut plane spiritus humanus (prout disponitur in hominibus singulis) sit res varia, et omnino perturbata, et quasi fortuita. Unde bene Heraclitus[43], homines scientias quærere in minoribus mundis, et non in majore sive communi.

XLIII.

Sunt etiam *idola* tanquam ex contractu et societate humani generis ad invicem, quæ *idola fori*, propter hominum commercium et consortium, appellamus[44].

where "each man's particular Dæmon, or seducing familiar spirit." In the 1st ed. of Southey's Joan of Arc, are some fine lines by Coleridge upon this thought of the Cave,

"We in this low world
Placed with our backs to bright Reality,
That we may learn with young unwonted ken
Things from their shadows. Know thyself my Soul!
Confirm'd thy strength, thy pinions fledged for flight,
Bursting this shell, and leaving next thy nest,
Soon upward soaring shalt thou fix intense
Thine eaglet eye on Heaven's eternal Sun!"

[43] Heraclitus 'the obscure' flourished about B.C. 500. He was an Ephesian, and so is usually classed with the Ionians, though his views were more like those of the Eleatic school. He made Fire the first ground of things; declared that there was no stability in nature; and worked in with this contempt of the evidences of the senses a contempt of man (ὀχλολοίδορος), of which the saying here referred to is an instance. The sentiment that the *Macrocosm* might be fully learnt from the *Microcosm* was a favourite with Paracelsus.

[44] *Idola Fori.* Prejudices springing from the faulty use of language in our intercourse with one another. (Words, the "notionum tesseræ," being analogous to money in the market-place.) We have already touched on language, I. 14, and its reaction on thought. The faulty use of terms is the greatest difficulty in all investigations. Mathematics and Chemistry have made their progress by building up a new nomenclature. It is a question how far Bacon is right in retaining the language of the Ancients out of a love of peace. From a dread of this Idolon, men have thought of establishing an en-

Homines enim per sermones sociantur; at verba ex captu vulgi imponuntur. Itaque mala et inepta verborum impositio miris modis intellectum obsidet. Neque definitiones aut explicationes, quibus homines docti se munire et vindicare in nonnullis consueverunt, rem ullo modo restituunt. Sed verba plane vim faciunt intellectui, et omnia turbant; et homines ad inanes et innumeras controversias et commenta deducunt.

XLIV.

Sunt denique *idola*, quæ immigrarunt in animos hominum ex diversis dogmatibus philosophiarum, ac etiam ex perversis legibus demonstrationum; quæ *idola theatri* nominamus[45]; quia quot philosophiæ receptæ aut inventæ sunt, tot fabulas productas et actas censemus, quæ mundos effecerunt fictitios et scenicos. Neque de his quæ jam habentur, aut etiam de veteribus philosophiis et sectis tantum loquimur, cum complures aliæ ejusmodi fabulæ componi et concinnari possint; quandoquidem errorum prorsus diversorum causæ sint nihilominus fere communes. Neque rursus de philosophiis universalibus tantum hoc intelligimus, sed etiam de principiis et axiomatibus compluribus scientiarum, quæ ex traditione et fide et neglectu invaluerunt.

tirely new Philosophical and Universal Language. For men ever vitiate their conceptions by the introduction of relative or analogous notions; and it was hoped the new Language might obviate this. The subject is treated at length in D. Stewart's Phil. of the Human Mind, part I. ch. iv. sect. 4, 5, and Note L on Leibnitz: cf. also the Introd. to the same work, part II. sect. 2 (§ 2), where he quotes Lavoisier on Chemistry and Algebra. The latter of these affords a striking illustration of the difference between Philosophy with and without a language of its own. Algebra never made progress till after Vieta introduced symbols into it, and then it shot forwards directly. Cf. also Advancement of Learning, p. 196.

[45] *Idola Theatri.* The prejudices arising from the different systems of Philosophy, and the faulty methods of Demonstration in vogue. This head, which brings Bacon to the edge of controversy, will be treated of at greater length hereafter.

Verum de singulis istis generibus *idolorum*, fusius et distinctius dicendum est, ut intellectui humano cautum sit.

XLV.

Intellectus humanus ex proprietate sua facile supponit majorem ordinem et æqualitatem in rebus, quam invenit[46]: et cum multa sint in natura monodica, et plena imparitatis, tamen affingit parallela, et correspondentia, et relativa, quæ non sunt. Hinc commenta illa, *in cœlestibus omnia moveri per circulos perfectos*, lineis spiralibus et draconibus[47] (nisi nomine tenus) prorsus rejectis. Hinc elementum ignis cum orbe suo[48] introductum est ad constituendum quaternionem

[46] Playfair (Encycl. Brit. I. Dissert. iii. p. 455) calls this head of "Idola Tribus," "the Spirit of System," arising from man's innate yearning after something definite, and after parallels and relations. This springs from our desire for rest: (cf. I. 20.) In the Adv. of Learning (p. 194) Bacon uses the same language as he does here, adding the beautiful illustration from the disorder of the stars in the firmament.

[47] "Dracones" Bacon himself englishes by "Eccentrics" in the Adv. of Learning: (cf. Milton's Par. Lost, viii. 79—84, and v. 620—624.) He knew nothing of Astronomy, and doubtless would look with as little favour on Kepler's laws, as on the "commenta" of the older Mathematicians. But though his illustration is not happy, his principle is just; a remark which would hold good of a large part of the Nov. Org. "Lineæ spirales et dracones" have given place to the simple and beautiful Laws of the motion of the planetary Bodies; but Bacon's warning against a love of uniformity must be repeated against all hasty generalisers.

[48] The Ancients made of the Elements four Orbs, concentric; *Earth* in the centre; then *Water*; then *Air*; and lastly *Fire*: as Milton writes;

"Air, and ye elements, the eldest birth
Of Nature's womb, that in quaternion run
Perpetual circle, multiform; and mix
And nourish all things." Par. Lost, v. 180.

And the "decupla proportio excessus" was a doctrine of R. Fludd's (an English Physician cotemporary with Bacon). The notion was that the Density of Earth is to that of Water as 10 is to 1: so too that of Water to that of Air, and that of Air to that of Fire.

It is scarcely necessary to add that (except for purposes of Poetry) the four Elements have disappeared under the hands of the Chemists. This whole subject trenches on the "Idola Theatri."

cum reliquis tribus, quæ subjiciuntur sensui. Etiam elementis (quæ vocant) imponitur ad placitum decupla proportio excessus in raritate ad invicem; et hujusmodi somnia. Neque vanitas ista tantum valet in dogmatibus, verum etiam in notionibus simplicibus.

XLVI.

Intellectus humanus in iis quæ semel placuerunt, (aut quia recepta sunt et credita, aut quia delectant) alia etiam omnia trahit ad suffragationem et consensum cum illis: et licet major sit instantiarum vis et copia, quæ occurrunt in contrarium; tamen eas aut non observat, aut contemnit, aut distinguendo summovet et rejicit, non sine magno et pernicioso præjudicio, quo prioribus illis syllepsibus auctoritas maneat inviolata[49]. Itaque recte respondit ille[50], qui, cum suspensa tabula in templo ei monstraretur eorum, qui vota solverant, quod naufragii periculo elapsi sint, atque interrogando premeretur, anne tum quidem Deorum numen agnosceret, quæsivit denuo, *At ubi sunt illi depicti qui post vota nuncupata perierint?* Eadem ratio est fere omnis superstitionis[51], ut in astrologicis, in somniis, ominibus, nemesibus, et hujusmodi; in quibus homines delectati hujusmodi vanitatibus advertunt eventus, ubi implentur; ast ubi fallunt, licet multo frequentius, tamen

[49] This disingenuous behaviour is as common in Philosophy as in life: and so this also trenches on the "Idola Theatri."

[50] Diagoras the Atheist. Aristoph. Ran. 320.: cf. also Cic. de Nat. Deor. iii. 37, where this anecdote is related. Religion suffers most from the false ground taken by its supporters. And so such an appeal to the Atheist failed. The error lay in that feebleness of faith among the Ancients, which led men to neglect the Truth that God does not grant every prayer; that He often acts rightly for us, when we pray wrongly for ourselves.

[51] Superstition, arising from a wrong view (1) of God's government, (2) of the Constitution of Nature as His work. The subject is treated at greater length infr. I. 65. and 89.

For the question of Bacon's belief, so violently impugned by Le Maistre and others, see Appendix C.

negligunt et prætereunt[52]. At longe subtilius serpit hoc malum in philosophiis et scientiis; in quibus quod semel placuit, reliqua (licet multo firmiora et potiora) inficit, et in ordinem redigit. Quinetiam licet abfuerit ea, quam diximus, delectatio et vanitas, is tamen humano intellectui error est proprius et perpetuus, ut magis moveatur et excitetur affirmativis, quam negativis; cum rite et ordine æquum se utrique præbere debeat; quin contra, in omni axiomate vero constituendo, major est vis instantiæ negativæ.

XLVII.

Intellectus humanus illis, quæ simul et subito mentem ferire et subire possunt, maxime movetur; a quibus phantasia[53] impleri et inflari consuevit: reliqua vero modo quodam, licet imperceptibili, ita se habere fingit et supponit, quomodo se habent pauca illa quibus mens obsidetur; ad illum vero transcursum ad instantias remotas et heterogeneas, per quas axiomata tanquam igne probantur[54], tardus omnino intellectus est,

[52] Instances of this popular delusion are innumerable. It arises partly from our unwillingness to reconsider a verdict (the love of Rest noticed above); partly from our being (it would seem) less able to register and notice the negative than the positive. There is less that one can take hold of in it.

[53] "Phantasia." The influence of the Imagination on the Judgment must differ in each temperament, though all persons feel it to some extent. It also affects the Will, and has great weight on Happiness, but this ἄλλης ἂν εἴη σκέψεως. The operation of the Affections on our Judgment—often of our Instincts—will be akin to this. A man who has once suffered a shock of any kind always feels it when similar cases occur, though he may know that there is no danger; and Imagination acting on these rapid and strong impressions does not allow Reason to pronounce calmly and deliberately. Nine tenths of mankind (and Aristotle would tell us all women without exception) act more from impulses of Imagination and feeling, than from Judgment. Then why do we so much forget the education—the right curbing, and giving proper objects to the Imagination? It stands between our Moral and our Intellectual nature: it exerts an untold influence on both, and can both increase our happiness and adorn our knowledge.

[54] This is the "exceptio quæ pro-

et inhabilis, nisi hoc illi per duras leges et violentum imperium imponatur.

XLVIII.

Gliscit intellectus humanus, neque consistere aut acquiescere potis est, sed ulterius petit[55]; at frustra. Itaque incogitabile est ut sit aliquid extremum aut extimum mundi, sed semper quasi necessario occurrit ut sit aliquid ulterius. Neque rursus cogitari potest quomodo æternitas defluxerit ad hunc diem[56]; cum distinctio illa, quæ recipi consuevit, quod sit *infinitum a parte ante, et a parte post,* nullo modo constare possit; quia inde sequeretur, quod sit unum infinitum alio infinito majus[57], atque ut consumatur infinitum, et vergat ad finitum. Similis est subtilitas de lineis sem-

bat regulam," the picking out such instances as will thoroughly test the validity of the general rule laid down. These are cases of ἐκλογή, such as we have in Bk. II. 21—52.

[55] A fact in Human Nature which is used as an evidence of our Immortality. This desire is both for the *infinite* and the *infinitesimal,* and so Bacon speaks of "lineæ semper divisibiles." In these matters the Reason of Man penetrates but little farther than his senses can lead him; and at the end he has nothing that he can say except "Omnia exeunt in Mysterium." By a *symbolical* system we can calculate and arrange beyond the possible limits of sense: but it is by no means clear that we are not therein only getting at so many more expressions of our Ignorance. The "Calculus," which Bacon's mind was clearly quite ready to accept, and of which many things in his writings were prophetical, teaches us the symbolical relations of "Orders of Infinities and of Infinitesimals:" it can do but little more. See Price on the Infinites. Calc. § 11, 103, and 158—160; Mill's Logic, Bk. II. chap. v. § 6; and Kant, Critik der reinen Vernunft, Pref. to 2nd edition.

[56] Cf. Mansel's Pamphlet on Eternity, p. 8, where the distinction between Eternity regarded as "unlimited duration" (i. e. an incomprehensible length of Time), and as "consciousness out of duration" (i. e. entirely disconnected from Time) is drawn out. Bacon says that (as far as Man's Reason may affirm any thing as to such points) it is impossible to conceive time finite and the infinite as going on together; a fact which is otherwise expressed in that Law of the Calculus, which states "that a finite quantity added to or taken from an infinite does not affect it."

[57] This is correct enough absolutely, but for certain purposes we have been obliged to consider "orders" of Infinity. These may hold with respect to us, but not to the Universe.

per divisibilibus, ex impotentia cogitationis. At majore cum pernicie intervenit hæc impotentia mentis in inventione causarum: nam cum maxime universalia in natura positiva esse debeant, quemadmodum inveniuntur[58], neque sunt revera causabilia; tamen intellectus humanus, nescius acquiescere, adhuc appetit notiora. Tum vero, ad ulteriora tendens, ad proximiora recidit, videlicet ad causas finales, quæ sunt plane ex natura hominis, potius quam universi[59]: atque ex hoc fonte philosophiam miris modis corruperunt. Est autem æque imperiti et leviter philosophantis, in maxime universalibus causam requirere, ac in subordinatis et subalternis causam non desiderare.

XLIX.

Intellectus humanus luminis sicci non est; sed recipit infusionem a voluntate et affectibus[60]; id quod

[58] All things "quemadmodum inveniuntur," i. e. in their real existence, are positive. The "Negative" refers to our method of approximating to a conception of them. "The more universal, the more positive." This may be: yet the more universal things are, the more we are driven to consider them by means of negatives. If taken strictly this passage must refer to the Deity, who alone is "non-causabilis." Bacon, I think, means by it the first principles of Nature. And his meaning will be best illustrated by a passage from D. Stewart's Phil. of the Human Mind, Introd. i. "In the investigation of Physical Laws it is well known that our enquiries must always terminate in some general fact, of which no account can be given but that such is the constitution of Nature;" e. g. such as the Law of Gravitation.

[59] Final Causes depend on our conceptions rather than on the Nature of Things; on our arbitrary suppositions as to the Intentions of Nature. They are attacked again Bk. II. 2: to which place the reader is referred.

[60] Spinosa attacked this notion as giving a wrong view of the origin of evil. It is borrowed from the Heraclitan αὔη ψυχὴ ἀρίστη. He connected the Moral and Physical by it. Bacon refers to this also in the Adv. of Learning, p. 12, where he quotes Heraclitus by name. He seems here to hold to the Aristotelian notion of the perfection of the pure Intellect—the αὐτὴ διάνοια of Eth. vi. 2. But can one affirm that, if free from Affections, the Intellect would of itself discern unerringly the True from the False. Is there not an Intellectual as well as a Moral dimness? or does the

generat *ad quod vult scientias:* quod enim mavult homo verum esse, id potius credit[61]. Rejicit itaque difficilia, ob inquirendi impatientiam; sobria, quia coarctant spem; altiora naturæ, propter superstitionem; lumen experientiæ, propter arrogantiam et fastum, ne videatur mens versari in vilibus et fluxis; paradoxa[62], propter opinionem vulgi; denique innumeris modis, iisque interdum imperceptibilibus, affectus intellectum imbuit et inficit.

L.

At longe maximum impedimentum et aberratio intellectus humani provenit a stupore et incompetentia et fallaciis sensuum[63]; ut ea, quæ sensum feriunt, illis, quæ sensum immediate non feriunt, licet potioribus, præponderent. Itaque contemplatio fere desinit cum aspectu; adeo ut rerum invisibilium exigua aut nulla sit observatio. Itaque omnis operatio spirituum[64] in

"depravation of Man's Nature" shew itself only in the lower part of us, and not in the higher?

In the "Cogitata et visa" Bacon speaks of an "Opinio *humida*."

[61] From Demosth. Ol. iii. ὃ γὰρ βούλεται τοῦθ' ἕκαστος οἴεται.

[62] The greatest Truths which have shone on the world have come first before the opinion of the Vulgar as Paradoxes.

[63] The infirmity of the senses was the Eleatic thesis, and a knowledge of their errors led to Bp. Berkeley's views.

[64] We here get upon Scholastic language. "Spiritus" was a term by which men covered their ignorance of the Processes of Nature. One cannot wonder that with all his dislike of the Schoolmen Bacon made use of their language. For his object was not to make a new nomenclature; and so he took such terms as he found in general use. And one may also believe that seeing something unexplained in the Processes of Nature he was willing to acquiesce (having no better views to put forward) in the language and theories of the Schoolmen. Locke, after him, made use of similar terms.

"If on some occasions Bacon assumes the existence of *Animal Spirits*, as the medium of communication between Soul and Body, it must be remembered, that this was then the universal belief of the Learned, and that it was at a much later period not less confidently avowed by Locke. Nor ought it to be overlooked (I mention it to the credit of *both* Authors) that in such instances the fact is commonly so stated as to render it easy for the reader to detach it from the Theory." D. Stewart's Encycl. Brit. vol. I. Diss. i. p. 33.

corporibus tangibilibus inclusorum latet, et homines fugit. Omnis etiam subtilior meta-schematismus in partibus rerum crassiorum (quam vulgo alterationem vocant, cum sit revera latio per minima[65]) latet similiter: et tamen nisi duo ista, quæ diximus, explorata fuerint et in lucem producta, nihil magni fieri potest in natura quoad opera. Rursus ipsa natura aëris communis et corporum omnium, quæ aërem tenuitate superant, (quæ plurima sunt) fere incognita est[66]. Sensus enim per se res infirma est, et aberrans: neque organa ad amplificandos sensus aut acuendos multum valent; sed omnis verior interpretatio naturæ conficitur per instantias, et experimenta idonea et apposita; ubi sensus de experimento tantum, experimentum de natura et re ipsa judicat.

LI.

Intellectus humanus fertur ad abstracta propter naturam propriam; atque ea, quæ fluxa sunt, fingit esse constantia. Melius autem est naturam secare, quam abstrahere; id quod Democriti schola fecit, quæ magis penetravit in naturam, quam reliquæ[67]. Materia potius considerari debet, et ejus schematismi, et meta-sche-

This Aphorism contains the germ of those in Bk. II. (2—7.), which describe Latent Process and Structure.

[65] "Latio per minima." The language afterwards used in the Calculus.

[66] Here is a longing after Modern Chemistry, whose grand discoveries Bacon would have so rejoiced to see—"quæ aërem tenuitate superant"—such as various gases, electricity, light, &c.

[67] Democritus of Abdera flourished at the time of the Peloponnesian War (B. C. 431). His school would be, I suppose, Leucippus alone. Bacon in his liking for the Philosophers before Plato evidently overrates their value. He seems to think that Democritus with his Atoms made more way into the knowledge of Things than the dogmatic Philosophers who "abstracted" instead of "dissecting" nature. He thought that the Atomic system approached more nearly to a discovery of structure and change of structure. That however he did not entirely approve of them is visible from infra I. 57.

matismi, atque actus purus[68], et lex actus sive motus; formæ enim commenta animi humani sunt, nisi libeat leges illas actus formas appellare[69].

LII.

Hujusmodi itaque sunt *idola*, quæ vocamus *idola tribus;* quæ ortum habent aut ex æqualitate substantiæ spiritus humani; aut ex præoccupatione ejus; aut ab angustiis ejus; aut ab inquieto motu ejus; aut ab infusione affectuum; aut ab incompetentia sensuum; aut ab impressionis modo.

LIII.

Idola specus ortum habent ex propria cujusque natura et animi et corporis; atque etiam ex educatione, et consuetudine, et fortuitis. Quod genus, licet sit varium et multiplex, tamen ea proponemus, in quibus maxima cautio est, quæque plurimum valent ad polluendum intellectum, ne sit purus.

LIV.

Adamant homines scientias et contemplationes particulares; aut quia auctores et inventores se earum credunt; aut quia plurimum in illis operæ posuerunt, iisque maxime assueverunt. Hujusmodi vero homines,

68 "Actus purus." Action or progress of any body regarded in and by itself, as if one should watch the growth of a plant. In all this one sees how Bacon hated the old *Dichotomies*, and longed for the Analysis of Modern Chemistry: for this is what is meant by "naturam secare."

69 *Formæ* or "leges actus:" cf. II. 1, &c., and Adv. of Learning, p. 139. For "Laws of Nature" see Mill's Logic, Bk. III. ch. iv. These are not "Forms" in the Baconian sense, but only the uniformities which exist among natural Phenomena (in other words the results of Induction stated summarily) when reduced to their simplest expression. Thus the Law of Gravity, that "Force varies inversely as the square of the Distance" ($F \propto \frac{1}{D^2}$), is a statement of *Fact*, not a "Formal Cause." But whether by "Leges Actus" Bacon meant Laws of Nature is not quite clear. What he opposes is clear enough, the Platonic χωριστὰ εἴδη, the Architypal Forms independent of Matter. Cf. D. Stewart's Phil. of Human Mind, part II. ch. ii. § 4.

si ad philosophiam et contemplationes universales se contulerint, illas ex prioribus phantasiis detorquent, et corrumpunt; id quod maxime conspicuum cernitur in Aristotele, qui naturalem suam philosophiam logicæ suæ prorsus mancipavit, ut eam fere inutilem et contentiosam reddiderit[70]. Chemicorum autem genus[71], ex paucis experimentis fornacis, philosophiam constituerunt phantasticam, et ad pauca spectantem: quinetiam Gilbertus[72], postquam in contemplationibus magnetis se laboriosissime exercuisset, confinxit statim philosophiam consentaneam rei apud ipsum præpollenti.

LV.

Maximum et velut radicale discrimen ingeniorum, quoad philosophiam et scientias, illud est; quod alia ingenia sint fortiora et aptiora ad notandas rerum

[70] For Bacon's opinions as to Aristotle see I. 63, where the subject comes properly before him under the "Idola Theatri." Here it is out of place; and we notice on several occasions that Bacon's love of illustration &c. has led him to pass the limits he has set to himself.

[71] The Chemists of Bacon's day were thoroughly empiric (cf. I. 64), for, as Playfair says (Encyclop. Brit. I. p. 453), "Chemistry in this state might be said to have an *Elective Attraction* for all that was most absurd and extravagant in the other parts of knowledge."

[72] Gilbert, court Physician to Elizabeth and James I, is always treated badly by Bacon. He ever asserted the great advantage of experiment over *a priori* philosophy; and is accordingly put by Bacon among "Empirics." He was a strong supporter of the Copernican system, and so far was in advance of Bacon. His fault was (if it was one) that he attached himself too much to one subject (Magnetism), and was inclined to expect too great results from it. Hallam says of him, that he, in a Latin Treatise on the Magnet, "collected all the knowledge which others had possessed on the subject, and became also at once the father of experimental Philosophy in this Island." His views are still held to be sound. Sarpi said that he and Vieta the Algebraist were the only two original writers of his day. Hallam, Lit. of Europe, vol. II. part ii. ch. 7. § 21. Bacon often refers to him: cf. I. 64. 70; II. 35; Adv. of Learning, p. 51. He allows him qualified praise in the 3rd Book of the De Augm. Sc. Galileo, in his 3rd Dialogue, discusses his system with great respect; contrasting very favourably with Bacon's almost personal abuse.

differentias; alia, ad notandas rerum similitudines[73]. Ingenia enim constantia et acuta figere contemplationes, et morari, et hærere in omni subtilitate differentiarum possunt: ingenia autem sublimia et discursiva etiam tenuissimas et catholicas rerum similitudines et agnoscunt et componunt: utrumque autem ingenium facile labitur in excessum, prensando aut gradus rerum, aut umbras.

LVI.

Reperiuntur ingenia alia in admirationem antiquitatis, alia in amorem et amplexum novitatis effusa[74]; pauca vero ejus temperamenti sunt, ut modum tenere possint, quin aut quæ recte posita sunt ab antiquis convellant, aut ea contemnant quæ recte afferuntur a novis. Hoc vero magno scientiarum et philosophiæ detrimento fit, quum studia potius sint antiquitatis et novitatis, quam judicia: veritas autem non a felicitate

[73] See on this Hallam's Lit. of Eur. vol. II. part iii. ch. iii. § 76. The highest minds have both characteristics. "And," as Hallam adds, "the inductive method is at once the best exercise of both, and the best safeguard against the excesses of either." Bacon, he holds, was more fond of resemblances than differences. He shews this in his Metaphors. "This is the case with men of a sanguine temper, warm fancy, and brilliant wit." In fact Genius best sees resemblances, Subtilty differences. See Macaulay's Essay on Bacon. The "knowledge of Differences" is the peculiar work of the Intellect. This is shadowed by the *Geschead-wissen* of the Anglo-Saxons.

[74] See Adv. of Learning, p. 47, and infra I. 84. This attachment to particular periods is akin to the preoccupation of the Feelings. (Cf. supr. I. 49.) Those who love Antiquity for its own sake are led to it either by the fact that—

"The past must ever win
A brightness from its being far,
And orb into the perfect Star
We saw not while we moved therein." Tennyson In Mem.

or by a natural instinct which hails antiquities as so many threads which connect us with our Ancestors. The absorbing love of Novelty is a result of that desire for excitement and stimulus which is natural to us, and which within bounds produces much good, but which, if suffered to rule us, must destroy all soundness of judgment.

temporis alicujus, quæ res varia est; sed a lumine naturæ et experientiæ, quod æternum est, petenda est. Itaque abneganda sunt ista studia; et videndum, ne intellectus ab illis ad consensum abripiatur.

LVII.

Contemplationes naturæ et corporum in simplicitate sua intellectum frangunt et comminuunt; contemplationes vero naturæ et corporum in compositione et configuratione sua intellectum stupefaciunt et solvunt [75]. Id optime cernitur in schola Leucippi et Democriti [76], collata cum reliquis philosophiis. Illa enim ita versatur in particulis rerum, ut fabricas fere negligat; reliquæ autem ita fabricas intuentur attonitæ, ut ad simplicitatem naturæ non penetrent: itaque alternandæ sunt contemplationes istæ, et vicissim sumendæ; ut intellectus reddatur simul penetrans et capax; et evitentur ea, quæ diximus, incommoda, atque *idola* ex iis provenientia.

LVIII.

Talis itaque esto prudentia contemplativa in arcendis et summovendis *idolis specus;* quæ aut ex prædominantia, aut ex excessu compositionis et divisionis, aut ex studiis erga tempora, aut ex objectis largis et minutis, maxime ortum habent. Generaliter autem pro suspecto habendum unicuique rerum naturam contemplanti quicquid intellectum suum potissimum capit et detinet [77]; tantoque major adhibenda in hujusmodi

[75] This "fallacy" arises from contemplation, as Bacon says (infr. I. 58), of "objecta larga et minuta," rather than of things as they are—Idealism, and Atomist speculations.

[76] These were the Atomists (cf. I. 51), who stood over against the Platonists who "fabricas intuentur attoniti." There is a chapter on Leucippus and Democritus in Ritter's Hist. of Anct. Phil. Bk. vi. ch. 2.

[77] This is the same rule that meets us in Moral difficulties also: *Σκοπεῖν δὲ δεῖ πρὸς ἃ καὶ αὐτοὶ εὐκατάφοροί ἐσμεν . . . . . εἰς τοὐναντίον δ' ἑαυτοὺς ἀφέλκειν δεῖ.* Ar. Eth. II. ix. 4.

placitis est cautio, ut intellectus servetur æquus et purus.

LIX.

At *idola fori*[78] omnium molestissima sunt; quæ ex fœdere verborum et nominum se insinuarunt in intellectum. Credunt enim homines, rationem suam verbis imperare. Sed fit etiam ut verba vim suam super intellectum retorqueant et reflectant; quod philosophiam et scientias reddidit sophisticas et inactivas. Verba autem plerunque ex captu vulgi induntur, atque per lineas, vulgari intellectui maxime conspicuas, res secant[79]. Quum autem intellectus acutior, aut observatio diligentior, eas lineas transferre velit, ut illæ sint magis secundum naturam; verba obstrepunt[80]. Unde fit, ut magnæ et solennes disputationes hominum doctorum sæpe in controversias circa verba et nomina desinant; a quibus (ex more et prudentia mathematicorum) incipere consultius foret, easque per definitiones in ordinem redigere. Quæ tamen definitiones, in natu-

[78] In the Encycl. Brit. vol. I. p. 34. Dugald Stewart says that this Aphorism may be considered as the Text of by far the most valuable part of Locke's Essay—that which relates to the imperfections and abuse of words. He also refers the reader to Memoirs by M. Prevost and M. Degerando on "Signs considered in their connextion with the Intellectual Operations:" (cf. also supra, I. 44.) See Locke on the Human Understanding, Bk. iii. ch. 10. The fetters of language are one of the penalties of social life, and of our dimness of knowledge. People stick to an unsuitable word, as they do to a foolish article of dress, from mere custom; and the multitude, who do not think, are content with the faulty conceptions; so (e. g.) to most people "Sunrise" and "Sunset" seem correct enough.

[79] To these "lineæ" Aristotle appeals, when he uses the argument of language and derivations in his Moral Treatises, and there he is proximately right; for there the ordinary moral sense of man impresses itself on language, and it is fair to treat words as σημεῖα of things. But in Physics it is not so; and the "lineæ" are made more for distinctness and convenience than for Truth. In Bacon's days too these lines were rendered doubly clear and untrue by the *dialectical* system of looking at things.

[80] "Verba obstrepunt," Words protest. This is the difficulty of a new nomenclature in an old Science. In a new subject it makes no matter.

ralibus et materiatis, huic malo mederi non possunt; quoniam et ipsæ definitiones ex verbis constant, et verba gignunt verba [81]: adeo ut necesse sit ad instantias particulares, earumque series et ordines recurrere; ut mox dicemus, quum ad modum et rationem constituendi notiones et axiomata deventum fuerit [82].

LX.

Idola, quæ per verba intellectui imponuntur, duorum generum sunt; aut enim sunt rerum nomina, quæ non sunt [83], (quemadmodum enim sunt res, quæ nomine carent, per inobservationem; ita sunt et nomina, quæ carent rebus, per suppositionem phantasticam) aut sunt nomina rerum, quæ sunt, sed confusa et male terminata, et temere et inæqualiter a rebus abstracta. Prioris generis sunt, fortuna [84], primum mobile [85], planetarum orbes [86], elementum ignis [87], et hujusmodi com-

[81] Such as the definitions of Pleasure, Sensation, Will, in which we are often deceived "specie verborum," while really we are no nearer knowledge than before.

[82] So we must betake ourselves to true Induction. As the Indistinctness of Terms and Conceptions react on each other, our only remedy is to bring them to bear on one another, and to correct one another by a continual appeal to facts.

[83] These two *Idola* which words impose on the Intellect are,

1. *Actual Error* in apprehension, when we imagine we have conceptions of things which have no existence.
2. *Indistinctness* of apprehension.

[84] "Fortune." "*Chance* is but the *pseudonyme* of God for those particular cases which he does not choose to subscribe openly with his own sign-manual;" i. e. under the name of τύχη we include all things which follow a law at present hidden from us. So writes Metastasio:

. . . . "il eterno giro,
Che sembra *caso*, ed è saper profondo."

[85] *Primum mobile.* "This first mover, in Ptolemy's Astronomy, was a supposed immense sphere or hollow globe, which included within it all the spheres, or Orbs of the planets and fixed stars, and turned itself and all these round the earth in twenty-four hours." Account of the Nov. Org. in the Library of Useful Knowledge, p. 23.

[86] These *Orbes* were supposed to be actual crystal spheres (cf. II. 46), in which the stars were set, and beyond those of the Planets was one, called the *Cœlum Stellatum*, on which the fixed stars were all fastened;

"The fixed stars, fixed in their orb that flies." Par. Lost, v. 176.

menta, quæ a vanis et falsis theoriis ortum habent. Atque hoc genus *idolorum* facilius ejicitur, quia per constantem abnegationem et antiquationem theoriarum exterminari possunt.

At alterum genus perplexum est, et alte hærens; quod ex mala et imperita abstractione excitatur. Exempli gratia, accipiatur aliquod verbum, (*humidum*, si placet) et videamus quomodo sibi constent, quæ per hoc verbum significantur: et invenietur verbum istud, *humidum*, nihil aliud quam nota confusa diversarum actionum, quæ nullam constantiam aut reductionem patiuntur. Significat enim et quod circa aliud corpus facile se circumfundit; et quod in se est indeterminabile, nec consistere potest; et quod facile cedit undique; et quod facile se dividit et dispergit; et quod facile se unit et colligit; et quod facile fluit et in motu ponitur; et quod alteri corpori facile adhæret, idque madefacit; et quod facile reducitur in liquidum, sive colliquatur, cum antea consisteret. Itaque quum ad hujus nominis prædicationem et impositionem ventum sit; si alia accipias, flamma humida est; si alia accipias, aer humidus non est; si alia, pulvis minutus humidus est; si alia, vitrum humidum est: ut facile appareat istam notionem ex aqua tantum, et communibus et vulgaribus liquoribus, absque ulla debita verificatione, temere abstractam esse.

In verbis autem gradus sunt quidam pravitatis et erroris. Minus vitiosum genus est nominum substantiæ alicujus, præsertim specierum infimarum, et bene deductarum; (nam notio cretæ, luti, bona; terræ, mala:) vitiosius genus est actionum, ut *generare, corrumpere, alterare:* vitiosissimum qualitatum, (exceptis objectis sensus immediatis) ut *gravis, levis, tenuis, densi,*

87 "Elementum ignis:" cf. supr. I. 45.

&c. et tamen in omnibus istis fieri non potest, quin sint aliæ notiones aliis paulo meliores, prout in sensum humanum incidit rerum copia[88].

LXI.

At *idola theatri* innata non sunt, nec occulto insinuata in intellectum; sed ex fabulis theoriarum[89], et perversis legibus demonstrationum, plane indita et recepta. In his autem confutationes tentare et suscipere consentaneum prorsus non est illis, quæ a nobis dicta sunt. Quum enim nec de principiis consentiamus, nec de demonstrationibus, tollitur omnis argumentatio. Id vero bono fit fato, ut antiquis suus constet honos. Nihil enim illis detrahitur, quum de via omnino quæstio sit. Claudus enim (ut dicitur) in via, antevertit cursorem extra viam. Etiam illud manifesto liquet, currenti extra viam, quo habilior sit et velocior, eo majorem contingere aberrationem.

Nostra vero inveniendi scientias ea est ratio, ut non multum ingeniorum acumini et robori relinquatur; sed quæ ingenia et intellectus fere exæquet[90]. Quemadmodum enim ad hoc ut linea recta fiat, aut circulus

[88] "Rerum copia;" i. e. according to each man's capacity for seeing facts; i. e. according to the natural powers of each.

It is possible, finally, to use words as mere Logical Symbols, and argue thence with perfect Logical validity; the formal Syllogism cannot in any way teach or even test *Truth*; and it has no concern with a system of Interpreting Nature. For Bacon seeks to define words according to the Truth of Nature, and for this the Syllogism is of no use. As to the Syllogism see Appendix B.

[89] The desire which Bacon has expressed "ut antiquis suus constet honos" does not bear much fruit, for he does not let the Ancients have much rest; nor is he even fair in his judgments of them.

[90] This has not been verified by the progress of the Physical Studies. (Cf. infr. I. 122.) See Macaulay's Essay on Bacon. One man's apprehension of facts, or power of memory, or critical faculty, or quickness in generalisation, must exceed another's. And far more, one man passes another in that "Mental Initiative," the prerogative of wise souls, which Bacon, at times, seems quite to ignore. See Coleridge's Table-Talk, Sept. 21, 1830, and Oct. 8, 1830.

perfectus describatur, multum est in constantia et exercitatione manus, si fiat ex vi manus propria, sin autem adhibeatur regula, aut circinus, parum aut nihil; omnino similis est nostra ratio. Licet autem confutationum particularium nullus sit usus; de sectis tamen et generibus hujusmodi theoriarum nonnihil dicendum est; atque etiam paulo post de signis exterioribus, quod se male habeant; et postremo de causis tantæ infelicitatis, et tam diuturni et generalis in errore consensus; ut ad vera minus difficilis sit aditus, et intellectus humanus volentius expurgetur, et *idola* dimittat.

LXII.

Idola theatri, sive theoriarum, multa sunt, et multo plura esse possunt, et aliquando fortasse erunt. Nisi enim, per multa jam sæcula, hominum ingenia circa religionem et theologiam occupata fuissent; atque etiam politiæ civiles (præsertim monarchiæ) ab istiusmodi novitatibus, etiam in contemplationibus, essent aversæ [91]; ut cum periculo et detrimento fortunarum suarum in illas homines incumbant, non solum præmio destituti, sed etiam contemptui et invidiæ expositi; complures aliæ proculdubio philosophiarum et theoriarum sectæ, similes illis, quæ magna varietate olim apud Græcos floruerunt, introductæ fuissent. Quemadmodum enim super *phænomena* ætheris plura *themata* cœli confingi possunt; similiter, et multo magis, super *phænomena* philosophiæ fundari possunt et constitui varia dogmata. Atque hujusmodi *theatri* fabulæ habent etiam illud, quod in theatro poetarum usu venit; ut narrationes fictæ ad scenam narrationibus ex historia

[91] Just as even now there are those found who on political grounds object to education. Perhaps Bacon had in his mind the persecution of Galileo.

veris concinniores sint et elegantiores, et quales quis magis vellet.

In genere autem, in materiam philosophiæ sumitur aut multum ex paucis, aut parum ex multis; ut utrinque philosophia super experientiæ et naturalis historiæ nimis angustam basin fundata sit, atque ex paucioribus, quam par est, pronunciet. Rationale[92] enim genus philosophantium ex experientia arripiunt varia et vulgaria, eaque neque certo comperta, nec diligenter examinata et pensitata; reliqua in meditatione atque ingenii agitatione ponunt.

Est et aliud genus philosophantium[93], qui in paucis experimentis sedulo et accurate elaborarunt, atque inde philosophias educere et confingere ausi sunt; reliqua miris modis ad ea detorquentes.

Est et tertium genus eorum[94], qui theologiam et traditiones ex fide et veneratione immiscent; inter quos vanitas nonnullorum, ad petendas et derivandas scientias, a spiritibus scilicet et geniis, deflexit; ita ut stirps errorum, et *philosophia falsa*, genere triplex sit: *sophistica, empirica, et superstitiosa.*

LXIII.

Primi generis exemplum in Aristotele maxime conspicuum est, qui philosophiam naturalem dialectica sua corrupit[95]; quum mundum ex categoriis effecerit;

92 "Rationale;" that of those who appeal solely to and trust in the *Reason*, without considering its relations to the external world, or consulting facts: cf. infr. I. 63.

93 Cf. infr. I. 64.

94 Cf. infr. I. 65.

95 Here follows the attack on Aristotle, which is foreshadowed in I. 54. What his opinion might have been worth at so tender an age, is not clear, but we have it from Rawley, that Bacon began to dislike Aristotle at the age of 16: "Not for the worthlessness of the Author, to whom he could ascribe all high attributes, but for the unfruitfulness of the way—being a Philosopher only strong for disputations and contentions, but barren of the production of work for the life of man." No man who set before himself that

animæ humanæ, nobilissimæ substantiæ, genus ex vocibus secundæ intentionis [96] tribuerit; negotium *densi* et *rari*, per quod corpora subeunt majores et minores

end which Bacon followed, could at any time like Aristotle; at the time when he lived we must make all allowance for his dislike. Two centuries before, Roger Bacon, his most wise forerunner, had written (MS. Cotton. Tit. fol. 130. cap. 8): "Si haberem potestatem super libros Aristotelis, ego facerem omnia cremari; quia non est nisi temporis amissio studere in illis, et caussa erroris, et multiplicatio ignorantiæ ultra id quod valeat explicari." The Schoolmen had by their "thorny disputations without fruit" applied the Aristotelian Logic, carried on by Porphyry, to the neglect of all appeals to facts, of all real progress in knowledge; and until their whole system was abolished there was no hope. A system which settled the universe deductively from "ens," which divided things into essence and attribute, which argued on things by the Figures, must give way before truth could emerge. These were indeed later applications of Aristotelian principles: but Bacon strikes at the source, not at the results. And even in Aristotle's own writings we have more Logic than is necessary. The Categories are an obstacle to Truth; and though we believe that Aristotle meant his Logic to be in itself strictly instrumental, still even the 1st Analytics are full of dogmatic applications, and illustrations drawn from arbitrary axioms. The 2nd Anal. are purposely a *material* treatise, being the application of the Syllogistic process to Necessary Matter, and to the discovery of *αἰτίαι*; and here as much as any where the evil appears. And yet with it all Aristotle was aware of the necessity of experiment and a certain Induction. (See Anal. Post. i. 18.) Nor do we think he should be so absolutely condemned as he is here. Personally he was a careful observer of facts, as well as both a subtle and a deep thinker, and his Hist. Animal. was, whatever Bacon may say in its disparagement, a far more striking work and far more truly an appeal to Nature, than the hasty and partial generalizations of the older Philosophers had been: and in his Moral and lesser treatises we discern a judicious knowledge of Human Nature, such as nothing but personal experience could ever have given. For a much fairer judgment on Aristotle see Herschel's Discourse on Nat. Phil. part II. ch. 3. § 101: see also D. Stewart, Phil. of the Human Mind, part II. chap. iii. sect. 3.

There is a yet fiercer attack on the ancient Philosophers in the "Resuscitatio," under the title "de Interpretatione Naturæ Sententiæ XII." There he charges Aristotle with, 1. abominable sophistry, 2. useless subtilty, and 3. a vile sporting with words.

[96] From the vagueness which envelopes "voces secundæ intentionis" it is hard to explain this great injustice done to the Human Soul. Bacon probably refers to the De Anima II. i. § 7 and 11, where Aristotle lays it down that the soul is an *οὐσία*, and also *ἐντελέχεια*; meaning probably by "secundæ intentionis voces," Terms which are of technical use in Philosophy. Whether this is the right meaning of the Phrase is not our question here.

dimensiones sive spatia[96], per frigidam distinctionem actus et potentiæ transegerit; motum singulis corporibus unicum et proprium, et, si participent ex alio motu, id aliunde moveri, asseruerit; et innumera alia, pro arbitrio suo, naturæ rerum imposuerit: magis ubique sollicitus quomodo quis respondendo se explicet, et aliquid reddatur in verbis positivum, quam de interna rerum veritate; quod etiam optime se ostendit in comparatione philosophiæ ejus, ad alias philosophias, quæ apud Græcos celebrabantur. Habent enim homoiomera Anaxagoræ[97], atomi Leucippi et Democriti[98], cœlum et terra Parmenidis[99], lis et amicitia Empedoclis[1], resolutio corporum in adiaphoram naturam ignis, et replicatio eorundem ad densum Heracliti[2], aliquid ex philosopho naturali; et rerum naturam, et experientiam, et corpora sapiunt; ubi Aristotelis physica nihil aliud quam dialecticæ voces plerunque sonet: quam etiam in metaphysicis sub solenniore nomine, et ut magis scilicet realis, non nominalis[3], retractavit.

96 This distinction between Density and Rarity, as relatively and not absolutely opposed, is good, and might have been applied with advantage to Heat and Cold.

97 Anaxagoras of Clazomenæ flourished circ. B.C. 450. He held that before the constitution of the world all was in a state of mixture, consisting of infinitely small parts or seeds of things: these are called *Homœomeriæ;* though whether Anaxagoras himself used the term may be doubted. See Ritter, Bk. iii. ch. viii (note): cf. Arist. Met. I. 3.

98 Leucippus and Democritus, cf. supr. I. 51.

99 Parmenides of Elea flourished circ. B.C. 460. He held that there are two ἀρχαί; which (see Ar. Met. I. 5.) were πῦρ and γῆ, not *cœlum* and *terra;* and that these are antagonist, and from them the world is evolved. Surely, putting on his dogmas the most favourable construction, we shall not find much in them to prefer even to the Aristotelian Physics.

1 Empedocles of Agrigentum flourished circ. B.C. 480. He held that *Love* (Bacon's *Amicitia*) was the one God—the true moving power—while the actual existing separations of things arise from discord (*lis*). The Greek terms are either φιλότης and Ἔρις, or φιλία and νεῖκος.

2 Heraclitus, cf. supr. I. 42.

3 "*Realis*, non *nominalis*." The Metaphysics professed to treat of the absolute nature of things *as they are*, not as they are *conceived*

Neque illud quenquam moveat, quod in libris ejus *De animalibus*[4], et in *Problematibus*, et in aliis suis tractatibus, versatio frequens sit in experimentis. Ille enim prius decreverat; neque experientiam ad constituenda decreta et axiomata rite consuluit; sed postquam pro arbitrio suo decrevisset, experientiam ad sua placita tortam circumducit, et captivam; ut hoc etiam nomine magis accusandus sit, quam sectatores ejus moderni (scholasticorum philosophorum genus) qui experientiam omnino deseruerunt.

LXIV.

At philosophiæ genus *empiricum*[5] placita magis deformia et monstrosa educit, quam *sophisticum* aut rationale genus; quia non in luce notionum vulgarium, (quæ licet tenuis sit et superficialis, tamen est quodammodo universalis, et ad multa pertinens) sed in paucorum experimentorum angustiis et obscuritate fundatum est. Itaque talis philosophia illis, qui in hujusmodi experimentis quotidie versantur, atque ex ipsis phantasiam contaminarunt, probabilis videtur, et quasi certa; cæteris, incredibilis et vana. Cujus exemplum notabile est in chemicis, eorumque dogmatibus; alibi autem vix hoc tempore invenitur, nisi forte in philosophia Gilberti[6]. Sed tamen circa hujusmodi philosophias cautio nullo modo prætermittenda erat; quia mente jam prævidemus et auguramur, si quando homines, nostris monitis excitati, ad experientiam se serio contulerint (valere jussis doctrinis sophisticis) tum demum,

or *expressed in Language*. Bacon's objection no doubt would be that Man's knowledge must necessarily depend on his conceptions.

[4] The *Hist. Animal.* of Aristotle was certainly a far more systematic and satisfactory collection than Bacon's Sylva Sylvarum is. And Bacon himself allows it no little honour in the Adv. of Learning, B. i. p. 44.

[5] The ἐμπειρία here attacked would be good so far as it is an appeal to facts: bad, in that it has no *Method* and no *Patience*.

[6] Gilbert of Colchester, cf. supr. I. 54.

propter præmaturam et præproperam intellectus festinationem, et saltum, sive volatum ad generalia[7], et rerum principia, fore, ut magnum ab hujusmodi philosophiis periculum immineat; cui malo etiam nunc obviam ire debemus.

LXV.

At corruptio philosophiæ ex *superstitione*[8], et theologia admista, latius omnino patet, et plurimum mali infert, aut in philosophias integras, aut in earum partes. Humanus enim intellectus non minus impressionibus phantasiæ est obnoxius, quam impressionibus vulgarium notionum. Pugnax enim genus philosophiæ et *sophisticum* illaqueat intellectum: at illud alterum phantasticum, et tumidum, et quasi poeticum, magis blanditur intellectui[9]. Inest enim homini quædam intellectus ambitio, non minor quam voluntatis; præsertim in ingeniis altis et elevatis[10].

Hujus autem generis exemplum inter Græcos illu-

[7] This apprehension is daily being verified in Quack Medicines, or in the theories of Phrenology, Electro-biology, &c.

It is an evil akin to that under Idola Tribus, I. 45, 46. And this "præpropera festinatio et saltus" should be compared with Bacon's statement of his own Method infra, I. 104—106.

[8] One of the passages cited as proving Bacon's infidelity. We must recollect that he is speaking of "Scientia *Humana*," and that deliberations on the Nature of Angels and other supra-sensible subjects had quite vitiated the Physics of the Schoolmen. Bacon here wishes, not to thrust out the Faith, but to keep each thing in its right place, as he shews by alluding at the end of this Aph. to Matth. xxii. 21. "Render unto Cæsar" &c. But cf. infr. I. 89. and Appendix C.

[9] This is levelled against the imaginative writings of Plato, who disliked strict Physics, and of whose Timæus Bacon seems to be thinking. The *ἀνάμνησις*, and the doctrine of absolute *Ideas* (if we interpret them rightly), must stand in the way of sound Physical knowledge. Their poetic value Bacon of course allowed, though he qualifies his observations with the epithet "tumidum."

[10] Ambition "the last weakness of a noble soul," and this both in Intellect and Will. That of the Will leads to Tyrannies; that of the Intellect to perilous ground and unbelief, or to that searching out of things unattainable, which Bacon here condemns.

cescit, præcipue in Pythagora[11], sed cum *superstitione* magis crassa et onerosa conjunctum; at periculosius et subtilius in Platone atque ejus schola. Invenitur etiam hoc genus mali in partibus philosophiarum reliquarum, introducendo formas abstractas, et causas finales, et causas primas; omittendo sæpissime medias, et hujusmodi[12]. Huic autem rei summa adhibenda est cautio. Pessima enim res est errorum *apotheosis*[13], et pro peste intellectus habenda est, si vanis accedat veneratio. Huic autem vanitati nonnulli ex modernis summa levitate ita indulserunt, ut in primo capitulo Geneseos, et in libro Job, et aliis Scripturis sacris, philosophiam naturalem fundare conati sint[14]; inter *viva quærentes mortua.* Tantoque magis hæc vanitas inhibenda venit, et coercenda, quia ex divinorum et humanorum malesana admistione, non solum educitur philosophia phantastica, sed etiam religio hæretica. Itaque

[11] Pythagoras flourished B. C. 550; born at Samos. Around him alone of Ancient Philosophers is thrown the miraculous halo of a Saint. Both in his views and in his life the *religious* element stands out most prominently; and on a religious basis were founded his systems both of Morals and Politics. Cf. Ritter's Hist. Phil. Bk. iv. ch. i. and Grote's Hist. of Greece, vol. IV.

[12] As in the Essay on Superstition Bacon has, in speaking of its causes, mentioned the taking an aim at Divine matters by Human; so here he objects to the converse fault of trying to discover Human matters by Divine.

[13] The Deification of Untruth is the greatest possible injustice towards truth; and so towards God: as Bacon says elsewhere, to believe otherwise is to make God a lover of lies.

[14] Such men would be Rob. Fludd, who wrote a "Mosaic Philosophy," in which he built a scheme of physics on the first chapters of Genesis; or Hutchinson. See Account of Nov. Org. in the L. U. K. p. 24. The modern antagonists of Geology are rightly here rebuked. The Bible is not a work on Physical Geognosy; it is intended for man's Spiritual and Moral wants, and is adapted to even the frailty of his language. We shall find in it no assertions contrary to the truths of Physics; though we do meet with language suited to the state of knowledge at the time of its delivery. But for this and Bacon's views upon this point see infr. I. 89. "Inter viva" &c. a strange and doubtful application of St. Luke xxiv. 5. Bacon's love of distant resemblances led him to it.

salutare admodum est, si mente sobria fidei tantum dentur quæ fidei sunt [15].

LXVI.

Et de malis auctoritatibus philosophiarum, quæ aut in *vulgaribus notionibus*, aut in *paucis experimentis*, aut in *superstitione* fundatæ sunt, jam dictum est. Dicendum porro est et de vitiosa materia contemplationum [16], præsertim in philosophia naturali. Inficitur autem intellectus humanus ex intuitu eorum, quæ in artibus mechanicis fiunt, in quibus corpora per compositiones aut separationes ut plurimum alterantur [17]; ut cogitet simile quiddam etiam in natura rerum universali fieri. Unde fluxit commentum illud elementorum, deque illorum concursu, ad constituenda corpora naturalia. Rursus, quum homo naturæ libertatem contemplatur, incidit in species rerum, animalium, plantarum, mineralium; unde facile in eam labitur cogitationem, ut existimet esse in natura quasdam formas rerum primarias, quas natura educere molitur; atque reliquam varietatem ex impedimentis et aberrationibus naturæ in opere suo conficiendo, aut ex diversarum specierum conflictu [18], et transplantatione alterius in alteram, pro-

[15] Allusion to St. Matth. xxii. 21. Bacon's mind clearly could dispense with "Mysteries;" not denying or disbelieving them, but setting them aside. In this (as in many other points) he forms a strong contrast to his cotemporary Sir T. Browne, whose mind seemed actually to require Mysteries as a part of its necessary sustenance. Rel. Med. ch. ix.

[16] This faultiness in the "matter of our Contemplations" arises either from our delighting to watch what is Synthetic, or from a love for such Analytic speculations as to the "Species rerum" as to lead to a belief in "primary forms." The former leads one to dissect "usque ad atomum," which must be presupposed for it: the latter introduces "occult properties" &c., with which the Scholastic physics so much abounded: see the end of this Aph.

[17] This former tendency is caused by seeing an analogy between Mechanical Arts, in their "Synthesis," and the operations of scientific Invention. Cf. D. Stewart's Phil. of the Human Mind, Introd. II. § 2.

[18] This "conflictus" of different "Forms" is a difficulty which Aristotle in the Met. suggests as an objection to the Platonic views.

venire. Atque prima cogitatio qualitates primas elementares, secunda proprietates occultas et virtutes specificas, nobis peperit; quarum utraque pertinet ad inania contemplationum compendia, in quibus acquiescit animus, et a solidioribus avertitur. At medici, in secundis rerum qualitatibus et operationibus, attrahendi, repellendi, attenuandi, inspissandi[19], dilatandi, astringendi, discutiendi, maturandi, et hujusmodi, operam præstant meliorem; atque, nisi ex illis duobus (quæ dixi) compendiis (qualitatibus scilicet elementaribus, et virtutibus specificis) illa altera (quæ recte notata sunt) corrumperent, reducendo illa ad primas qualitates, earumque mixturas subtiles et incommensurabiles; aut ea non producendo, cum majore et diligentiore observatione, ad qualitates tertias et quartas, sed contemplationem intempestive abrumpendo; illi multo melius profecissent. Neque hujusmodi virtutes (non dico eædem, sed similes) in humani corporis medicinis tantum exquirendæ sunt; sed etiam in cæterorum corporum naturalium mutationibus.

Sed multo adhuc majore cum malo fit, quod quiescentia rerum principia, *ex quibus*[20]; et non moventia, *per quæ* res fiunt, contemplentur et inquirant. Illa enim ad sermones, ista ad opera spectant. Neque enim vulgares illæ differentiæ motus, quæ in naturali philosophia recepta notantur, *generationis*, *corruptionis*, *augmentationis*, *diminutionis*, *alterationis*, et *lationis*[21],

[19] *Inspissandi* stands over against *Attenuandi;* its meaning being "condensation." It does not occur in Latin writers.

[20] *Ex quibus*, the prime integral elements of things. *Per quæ*, the Efficients, causes of production &c. The former, elemental principles, are either entirely fictitious or not within our reach. The latter, the moving powers, correspond to what Bacon elsewhere terms "media," which he says are so much neglected. Cf. Playfair Encycl. Brit. vol. I. Diss. iii. p. 450.

[21] These are Aristotle's six kinds of *κίνησις*. Ar. Cat. xi. 1. *κινήσεως εἴδη ἕξ, γένεσις, φθορὰ, αὔξησις,*

ullius sunt pretii. Quippe hoc sibi volunt; si corpus, alias non mutatum, loco tamen moveatur, hoc *lationem* esse; si, manente et loco et specie, qualitate mutetur, hoc *alterationem* esse; si vero ex illa mutatione moles ipsa, et quantitas corporis non eadem maneat, hoc *augmentationis* et *diminutionis* motum esse; si eatenus mutentur, ut speciem ipsam et substantiam mutent, et in alia migrent, hoc *generationem* et *corruptionem* esse. At ista mere popularia sunt, et nullo modo in naturam penetrant; suntque mensuræ et periodi tantum, non species motus. Innuunt enim illud, *hucusque*, et non, *quomodo*, vel *ex quo fonte*. Neque enim de corporum appetitu, aut de partium eorum processu, aliquid significant; sed tantum quum motus ille rem aliter ac prius, crasso modo, sensui exhibeat, inde divisionem suam auspicantur. Etiam quum de causis motuum aliquid significare volunt, atque divisionem ex illis instituere, differentiam motus naturalis et violenti, maxima cum socordia, introducunt[22]; quæ et ipsa omnino ex notione vulgari est; cum omnis motus violentus etiam naturalis revera sit, scilicet cum externum efficiens naturam alio modo in opere ponet, quam quo prius.

At hisce omissis; si quis (exempli gratia) observaverit, inesse corporibus appetitum contactus[23] ad invicem,

μείωσις, ἀλλοίωσις, καὶ ἡ κατὰ τόπον μεταβολή. For Bacon's use of *Motus* see Bk. II. 48.

[22] This division of Motion is (as Bacon says) untenable. The real simplicity of the Laws of Motion as we now know them was hidden from his eyes; as we may see by his confused divisions in II. 48, where (under Motus libertatis, No. 3) he tries to explain what that which the ancients called "Violent Motion" is.

[23] Three subjects touched on: (1) a dim notion of *Attraction*, based on the old opinion as to Nature's "abhorrence of a Vacuum," an opinion universally held in Bacon's days, and assumed by Galileo as a principle in his physics. Torricelli by means of the Barometer first shook men's faith in it. See Herschel's Discourse on Nat. Phil. § 244—246. Pascal has the honour of having clearly

ut non patiantur unitatem naturæ prorsus dirimi aut abscindi, ut vacuum detur: aut si quis dicat, inesse corporibus appetitum se recipiendi in naturalem suam dimensionem vel tensuram, ut, si ultra eam, aut citra eam, comprimantur aut distrahantur, statim in veterem sphæram et exporrectionem suam se recuperare et remittere moliantur: aut si quis dicat, inesse corporibus appetitum congregationis ad massas connaturalium suorum, densorum videlicet versus orbem terræ, tenuiorum et rariorum versus ambitum cœli: hæc et hujusmodi vere physica sunt genera motuum. At illa altera plane logica sunt et scholastica, ut ex hac collatione eorum manifesto liquet.

Neque minus etiam malum est, quod in philosophiis et contemplationibus suis, in principiis rerum atque ultimatibus naturæ investigandis et tractandis, opera insumatur; cum omnis utilitas et facultas operandi in mediis consistat. Hinc fit, ut abstrahere naturam homines non desinant, donec ad materiam potentialem et informem ventum fuerit; nec rursus secare naturam desinant, donec perventum fuerit ad atomum; quæ, etiamsi vera essent, tamen ad juvandas hominum fortunas parum possunt.

disproved it by a "crucial Instance" with the Barometer on a high Mountain. (2) The second illustration is *Elasticity;* and (3) the last, an erroneous principle of *affinities* of homogeneous bodies, introducing the mistaken conception of *absolute density and levity*. (Cf. also II. 46. and 48.) The notion of absolute levity was disproved by shewing that the Phlogiston of Stahl was a mere fiction. Herschel's Discourse on Nat. Phil. § 336. Playfair in Encycl. Brit. vol. I. p. 450. The belief that things heavy naturally descend, and things light ascend by the appetite of their own nature, is Peripatetic. See Aristotle's Phys. Ausc. IV. v. 13. Τὸ *μέσον τοῦ οὐρανοῦ, καὶ τὸ ἔσχατον τὸ πρὸς ἡμᾶς τῆς κύκλῳ φορᾶς, δοκεῖ εἶναι τὸ μὲν ἄνω, τὸ δὲ κάτω, μάλιστα πᾶσι κυρίως, ὅτι τὸ μὲν αἰεὶ μένει, τοῦ δὲ κύκλου τὸ ἔσχατον ὡσαύτως ἔχον μένει. Ὥστε, ἐπεὶ τὸ μὲν κοῦφον, τὸ ἄνω φερόμενόν ἐστι φύσει, τὸ δὲ βαρὺ τὸ κάτω, κ. τ. λ.* Cf. infr. II. 35.

LXVII.

Danda est etiam cautio intellectui de intemperantiis philosophiarum, quoad assensum præbendum aut cohibendum; quia hujusmodi intemperantiæ videntur *idola* figere, et quodammodo perpetuare, ne detur aditus ad ea summovenda.

Duplex autem est excessus: alter eorum, qui facile *pronunciant*, et scientias reddunt positivas et magistrales; alter eorum, qui *acatalepsiam* introduxerunt, et inquisitionem vagam sine termino[24]. Quorum primus

[24] We have had this division of Philosophic schools in the Preface; see also supr. I. 37.

By the Dogmatists Bacon means all those who appeal from facts to the Intellect, and who so render Science positive and unchangeable; not because of its agreement with the facts of the world, but because of its answering to their preconceived opinions. Of these he considers Aristotle to have been the great leader; and after him the Schoolmen, whose Logical Theology he peculiarly disliked, as resisting all improvement and progress. It is quite true that from his excessive love of System, Aristotle did introduce much Dogmatism into his works: still we must not forget his constant references to the ὕλη of his treatises, and the distinction he draws between those in necessary and those in contingent matter; in the latter of which (viz. Ethics, Poetics, Rhetoric, and part of his Physics), he appeals to Nature to a certain extent; though often, it must be allowed, after he had made up his mind as to the Truth. And every one must have felt some anger at his unfair way of setting up objections to be refuted. Still his knowledge of Nature was deep and wide, and his experience very great, and a sweeping condemnation of him and of his writings is absurd. The Sophists also dogmatised, as too did both Stoics and Epicureans, as Bacon shews, quoting Velleius the Epicurean, in the Adv. of Learning, Bk. i. p. 52. "Nil tam metuens, quam ne dubitare aliqua de re videretur." (Cic. de Nat. Deor. i.)

From the Sophistic arrogance of Dogmatism, as a reaction, sprang the Pyrrhonist Scepticism, which led at last to the Ἀκαταληψία of the New Academy. (See note on I. 37.) Plato, "per jocum et Ironiam," or rather, perhaps, Socrates, (for Plato's mind was really more affirmative than negative,) began the Sceptical System. The Sophistical tenets, which combined unbelief, and almost Scepticism, with an immoral tendency, brought it about. Πάντων μέτρον ἄνθρωπος is a thoroughly sceptical statement, and directly strikes at the whole notion of "Objective" Truth. While, on the other hand, Plato's devotion to "Objective certainties," as shewn in his *Ideas*, in his Mythes, in his grand views as to the Deity, and his utter abhorrence of Physics, tended to bring men to the opinion (already promulgated by the Eleatic school)

intellectum deprimit, alter enervat. Nam Aristotelis philosophia, postquam cæteras philosophias (more Otto-

that in the world of Sense there can be nothing certain, nothing known. But Plato himself does not hold this absolutely (though the Cave in the Republic, Bk. vii. 1, looks rather like it), and it is a side view of his mind which would lead us to class him with the Sceptical Philosophers. But, of course, extreme views on neither side are fully developed by the first teachers. Socrates with his εἰρώνεια, his μηδὲν γινώσκειν, is far more like a Sceptic; though he brought it in to overthrow his arrogant antagonists, which was also his object in holding so many *negative* discussions.

The *Pyrrhonists* take their name from Pyrrho of Elis, who flourished circ. B.C. 340. They are to be distinguished from the New Academy; for they *doubted*, without either affirming or denying: so in Cic. Tusc. Quæst. i. "Chius Metrodorus. . . . Nego, inquit, scire nos, sciamusne aliquid, an nihil sciamus; ne id ipsum quidem nescire aut scire, scire nos; nec omnino sitne aliquid, an nihil sit." Entire suspension of judgment (ἐποχή) is the mental condition of the true Sceptic—a condition affirmed to be one of perfect happiness; and perhaps, remembering how men succeed in retaining this ἐποχή through life, and seem to cherish such a mental indecision, there may be something in the view. But the Sceptics did not go so far as the New Academy, who "Acatalepsiam dogmatizaverunt, et ex professo tenuerunt," "affirming" (as Sir T. Browne in the Rel. Med. i. § 55. says) "they knew nothing, and even in that opinion confuting themselves, and thinking that they knew more than all the world besides:" and so Lucretius (iv. 471) writes of them,

> "Nihil scire si quis putat, id quoque nescit
> An sciri possit; quoniam nil scire fatetur."

Dugald Stewart opposes Credulity to Scepticism, rather regarding opposites in the Human Mind than Schools of Philosophy. Bacon's chief distinction here is between those who admitted no doubts, and those who confounded all by declaring all things doubtful: while he afterwards distinguishes between these (the Sceptics) and the New Academy, who declared that though nothing could be possibly known as certain, yet many things might be pursued as probable: and so escaped the practical absurdities arising from Pyrrhonism.

Pascal disposes of both extremes in very few words, "La Nature confond les Pyrrhoniens, et la Raison les Dogmatistes" (see his Pensées, Art. viii. 1, where the whole matter is well discussed); or as Hume (in his Essays) says, "The great subverter of Pyrrhonism is Action and Employment, and the occupations of common life." Dugald Stewart also points out the fact that *doubt* may be as much the fashion as *dogmatism;* and as Rousseau says, "He who at the end of the 18th century has brought himself to abandon all his early principles without discrimination, would probably have been a Bigot in the days of the League."

See Diog. Laert. vit. Pyrrhon., and vit. Anaxarch.; also Dr. Jeremie's Essay on Sextus Empiricus and the Sceptics, Encycl. Metrop.;

manorum erga fratres suos) pugnacibus confutationibus contrucidasset, de singulis pronunciavit; et ipse rursus quæstiones ex arbitrio suo subornat, deinde conficit; ut omnia certa sint et decreta: quod etiam apud successiones suas valet, et in usu est.

At Platonis schola *acatalepsiam* introduxit, primo tanquam per jocum et ironiam, in odium veterum sophistarum, Protagoræ, Hippiæ, et reliquorum, qui nihil tam verebantur, quam ne dubitare de re aliqua viderentur. At nova academia *acatalepsiam* dogmatizavit, et ex professo tenuit: quæ licet honestior ratio sit, quam *pronunciandi* licentia, quum ipsi pro se dicant, se minime confundere inquisitionem, ut Pyrrho fecit et Ephectici[25], sed habere quod sequantur ut probabile, licet non habeant quod teneant ut verum; tamen postquam animus humanus de veritate invenienda semel desperaverit, omnina omnia fiunt languidiora: ex quo fit, ut deflectant homines potius ad amœnas disputationes et discursus, et rerum quasdam peragrationes, quam in severitate inquisitionis se susti-

D. Stewart's Phil. of the Human Mind, Introd. II. § 1.

What view did Bacon then take? We shall find an answer in this whole work; and in a short form in one of the wise sayings in the Adv. of Learning (p.51): "If a man will begin with certainties, he shall end in doubts; but if he will be content to begin with doubts, he shall end in certainties." His was the just doubtfulness of Caution, such as Descartes brought in as a preparation for philosophical investigation: a determination to judge nothing without sufficient data: to appeal first to facts; and if nature gives no reply still to suspend judgment; a willingness, too, to narrow the field of our observations; to take a more humble view of our powers of mind; to wait patiently till we see the truths of Nature, and not to content ourselves with the phantoms of the Imagination, or the baseless theories of the Intellect. This is the true ἐποχή, which slowly indeed, but all the more surely, has led to just views of things, and to a practical 'Truth and Utility' such as Bacon set before himself, and left it to posterity to attain to: cf. also infra I. 126.

[25] "Ephectici." "Ephectica (Philosophia) dicitur ab eventu, quod post inquisitionem ambigatur itidem." Diog. Laert. vita Pyrrh.

They enjoyed many names—ἀπορητικοὶ, σκηπτικοί, ἐφεκτικοί, ζητητικοί.

neant. Verum, quod a principio diximus, et perpetuo agimus, sensui et intellectui humano, eorumque infirmitati, auctoritas non est deroganda, sed auxilia præbenda.

LXVIII.[26]

Atque de *idolorum* singulis generibus, eorumque apparatu, jam diximus; quæ omnia constanti et solenni decreto sunt abneganda et renuncianda, et intellectus ab iis omnino liberandus est et expurgandus; ut non alius fere sit aditus ad regnum hominis, quod fundatur in scientiis, quam ad regnum cœlorum, *in quod, nisi sub persona infantis, intrare non datur*[27].

LXIX.[28]

At pravæ demonstrationes, *idolorum* veluti munitiones quædam sunt et præsidia; eæque, quas in dialecticis habemus, id fere agunt, ut mundum plane cogitationibus humanis, cogitationes autem verbis addicant et mancipent. Demonstrationes vero potentia quadam philosophiæ ipsæ sunt et scientiæ. Quales enim eæ sunt, ac prout rite aut male institutæ, tales sequuntur philosophiæ et contemplationes. Fallunt autem, et incompetentes sunt eæ, quibus utimur in universo illo processu, qui a sensu et rebus ducit ad axiomata et conclusiones. Qui quidem processus quadruplex est, et vitia ejus totidem. Primo, impressiones sensus[29]

[26] Is this Aphorism quite in its right place?

[27] Cf. D. Stewart's remarks on Education with a view to this cleansing out of errors. Phil. of the Human Mind, Introd. II. § 1.

"Sub persona infantis" refers to Matth. xviii. 3.

[28] In this Aphorism we go on to consider the "perversæ leges demonstrationum"—the second division of *Idola Theatri*. These are not only faulty and useless Ancient Deduction (for which see supr. I. 11—12. and Appendix B.), but also Ancient Induction. For this and for Bacon's own Induction see App. D. and infra I. 104, 105.

[29] "Impressiones sensus vitiosæ." In an exaggerated sense this was the basis of the Eleatic and Sceptical dogmas. In its correct sense a necessary caution. See Bp. Berkeley's *Siris*.

ipsius vitiosæ sunt; sensus enim et destituit et fallit. At destitutionibus substitutiones, fallaciis rectificationes debentur. Secundo, notiones ab impressionibus sensuum male abstrahuntur; et interminatæ et confusæ sunt, quas terminatas et bene finitas esse oportuit. Tertio, inductio mala est, quæ per enumerationem simplicem principia concludit scientiarum, non adhibitis exclusionibus et solutionibus, sive separationibus naturæ debitis. Postremo, modus ille inveniendi et probandi, ut primo principia maxime generalia constituantur, deinde media axiomata ad ea applicentur et probentur, errorum mater est, et scientiarum omnium calamitas. Verum de istis, quæ jam obiter perstringimus, fusius[30] dicemus, quum veram interpretandæ naturæ viam, absolutis istis expiationibus et expurgationibus mentis, proponemus.

LXX.

Sed demonstratio longe optima est experientia[31]; modo hæreat in ipso experimento. Nam si traducatur ad alia, quæ similia existimantur, nisi rite et ordine fiat illa traductio, res fallax est. At modus experiendi, quo homines nunc utuntur, cæcus est et stupidus. Itaque cum errant et vagantur nulla via certa, sed ex occursu rerum tantum consilium capiunt, circumferuntur ad multa, sed parum promovent; et quandoque gestiunt, quandoque distrahuntur; et semper inveniunt quod ulterius quærant. Fere autem ita fit, ut homines leviter et tanquam per ludum experiantur, variando

30 "fusius" in I. 100—105.

31 The faults of Experience usually are—

1. Want of a method of selection (to be remedied by Prerogatives).

2. Flimsy and insufficient variation of experiments.

3. Pursuit of one experiment, or subject, to the neglect of all others.

4. Eagerness to get at the practical application.

paululum experimenta jam cognita; et, si res non succedat, fastidiendo, et conatum deserendo. Quod si magis serio et constanter ac laboriose ad experimenta se accingant; tamen in uno aliquo experimento eruendo operam collocant; quemadmodum Gilbertus in magnete, chemici in auro. Hoc autem faciunt homines, instituto non minus imperito, quam tenui. Nemo enim alicujus rei naturam in ipsa re feliciter perscrutatur; sed amplianda est inquisitio ad magis communia.

Quod si etiam scientiam quandam et dogmata ex experimentis moliantur; tamen semper fere studio præpropero et intempestivo deflectunt ad praxin: non tantum propter usum et fructum ejusmodi praxeos, sed ut in opere aliquo novo veluti pignus sibi arripiant, se non inutiliter in reliquis versaturos: atque etiam aliis se venditent[32], ad existimationem meliorem comparandam de iis in quibus occupati sunt. Ita fit, ut, more Atalantæ, de via decedant ad tollendum aureum pomum[33]; interim vero cursum interrumpant, et victoriam emittant e manibus. Verum in experientiæ vero curriculo, eoque ad nova opera producendo, divina Sapientia[34] omnino et ordo pro exemplari sumenda sunt. Deus autem primo die creationis lucem tantum creavit, eique operi diem integrum attribuit; nec aliquid materiati operis eo die creavit. Similiter et ex

32 "aliis se venditent." Translators have treated this phrase oddly. One gives it "Insinuate themselves with others;" which, though not absolutely wrong, is faulty, as introducing a different conception from that which Bacon wished to give. Another translates "by making themselves conspicuous," which is nearer perhaps. "*puff themselves*," as tradesmen do their wares, is the right sense.

33 This simile of Atalanta is a favourite. It occurs again infr. I. 147. and in the Advancement of Learning. Also in the Filum Labyr. § 5.

34 The Editions of the Nov. Org. all read Prudentia: but as in the Edition of 1620 Bacon has placed among the Corrigenda the word *Sapientia,* I have thought it best to insert it in the text.

omnimoda experientia, primum inventio causarum et axiomatum verorum elicienda est: et lucifera experimenta, non fructifera quærenda[35]. Axiomata autem recte inventa et constituta praxin non strictim, sed confertim instruunt; et operum agmina ac turmas post se trahunt. Verum de experiendi viis, quæ non minus quam viæ judicandi obsessæ sunt et interclusæ, postea dicemus; impræsentiarum de experientia vulgari, tanquam de mala demonstratione, tantum loquuti. Jam vero postulat ordo rerum, ut de iis, quorum paulo ante mentionem fecimus, signis [36], (quod philosophiæ et contemplationes in usu male se habeant) et de causis rei primo intuitu tam mirabilis et incredibilis, quædam subjungamus. Signorum enim notio præparat assensum: causarum vero explicatio tollit miraculum. Quæ duo ad extirpationem *idolorum* ex intellectu faciliorem et clementiorem multum juvant.

LXXI.[37]

Scientiæ, quas habemus, fere a Græcis fluxerunt. Quæ enim scriptores Romani, aut Arabes, aut recentiores addiderunt, non multa, aut magni momenti sunt: et qualiacunque sint, fundata sunt super basin eorum quæ inventa sunt a Græcis. Erat autem sapientia Græ-

[35] Light and knowledge first. Fruit will follow in due time. Cf. I. 99. 117. 121.

[36] Cf. I. 61. ad fin.

[37] This Aph. contains a fierce attack on the older systems: and here as much as any where we are inclined to say with Mr. Maurice, "Bacon failed in the homage due to his great predecessors." If he had only differed from them it might have been borne: but he also shews so unfriendly a spirit towards his contemporaries, that one is inclined to believe that he regarded all thinking men as his rivals. His excuse is, that some ages being times of crisis must fail in reverence—and those times in which Bacon lived were, of all others, the days in which the old lost all its fictitious, and perhaps some of its real, value. There must be Iconoclasts whenever any thing great is to be done. But one might have hoped that the greatest minds would have acted as moderators, not inflamers. See Coleridge's Friend, s. II. Essay.

corum professoria, et in disputationes effusa: quod genus inquisitioni veritatis adversissimum est. Itaque nomen illud sophistarum, quod per contemptum ab iis, qui se philosophos haberi voluerunt, in antiquos rhetores rejectum et traductum est, Gorgiam, Protagoram, Hippiam, Polum[38], etiam universo generi competit, Platoni, Aristoteli, Zenoni[39], Epicuro[40], Theophrasto[41]; et eorum successoribus, Chrysippo, Carneadi[42], reliquis. Hoc tantum intererat; quod prius genus vagum fuerit et mercenarium[43], civitates circumcursando, et sapien-

38 Gorgias, &c. four of the chief "Sophists," "teachers of the average Morality and Principle of Athens:" for them see Grote's History of Greece, vol. viii. p. 486.—and Notes and Appendix II. to Shepperd's Edition of Theophrastus' Characters, chap. iii.

39 Zeno the founder of the Stoic School flourished B. C. 280.

40 Epicurus flourished circ. B. C. 300. His peculiar views have affinity to the Peripatetic School, as those of the Stoics to some parts of the Platonic. The two divisions (of those who cherished and wished to guide our affections, considering them good in themselves, and of those who were for ejecting them as definitely bad) have always existed among men, and are to be looked on as the assertion of the two contradictory parts of man's consciousness: his consciousness that God has made him for good, and that his whole nature—whether intellectual, moral, or physical, is intended to be good; and his consciousness that however he may try to hide it, he has in himself evil, and disobedience against the true order of God's world. For according to a fine passage in Hierocles—*Φιλοσοφία ἐστι ζώης ἀνθρωπίνης κάθαρσις καὶ τελειότης—κάθαρσις μὲν ἀπὸ τῆς ὑλικῆς ἀλογίας—τελειότης δὲ, τῆς οἰκείας εὐζωΐας ἀνάληψις πρὸς τὴν θείαν ὁμοίωσιν ἐπανάγουσα.* And after all, though the two schools flourish to this day, Christianity alone can bridge over the gulf between them, and reconcile two (to man's comprehension) contradictory principles of life.

41 Theophrastus, the Lesbian, was the successor of Aristotle, and tended the earlier Peripatetic School. He is best known to us by his "Characters," which are brilliant and witty, and shew a great insight into Human Nature. His views were lower than his master's—perhaps the specimens of mankind before his eyes did not tend to elevate his notions. Bacon gives no credit for the careful observation and penetration into character and motives, which are to be seen both in his writings and in those of Aristotle.

42 Chrysippus and Carneades. Chrysippus was follower of Cleanthes as head of the Stoics, and opposed the ultra-sceptical tendencies of the New Academy. Carneades was a few years his junior (born circ. B. C. 308), and was the follower of Arcesilaus as head of the New Academy.

43 Were the Sophists mercenary? see Grote's History of Greece, vol.

tiam suam ostentando, et mercedem exigendo: alterum vero solennius et generosius, quippe eorum qui sedes fixas habuerunt, et scholas aperuerunt, et gratis philosophati sunt. Sed tamen utrumque genus (licet cætera dispar) professorium erat, et ad disputationes rem deducebat, et sectas quasdam atque hæreses philosophiæ instituebat et propugnabat: ut essent fere doctrinæ eorum (quod non male cavillatus est Dionysius in Platonem) *Verba otiosorum senum ad imperitos juvenes*[44]. At antiquiores illi ex Græcis, Empedocles, Anaxagoras, Leucippus, Democritus, Parmenides, Heraclitus, Xenophanes, Philolaus, reliqui, (nam Pythagoram, ut superstitiosum, omittimus) scholas[45] (quod novimus) non aperuerunt: sed majore silentio, et severius, et simplicius, id est, minore cum affectatione et ostentatione, ad inquisitionem veritatis se contulerunt[46]. Itaque et melius, ut arbitramur, se gesserunt; nisi quod opera eorum a levioribus istis, qui vulgari captui et affectui magis respondent ac placent, tractu temporis extincta sint: tempore (ut fluvio) leviora et magis inflata ad nos devehente, graviora et solida mergente[47]. Neque tamen isti a nationis vitio prorsus

viii. p. 486; and against him a well written Appendix to Sheppard's edition of Theophrastus.

44 Cf. Adv. of Learning, p. 42. The Dionysius here mentioned was the elder, the son of Hermocrates. The interview, in the course of which this was said, is given in Diog. Laert. III. 18.

45 "Scholas." i. e. shewed no symptoms of schism and antagonism of sects, which was the "nationis vitium" mentioned below, and which turned the search after truth into subtilty of disputatious skill.

46 Sir W. Herschel in his Discourse on Nat. Phil. part. II. ch. iii. § 98. "The spirit of rational inquiry into Nature seems, if we can judge from the uncertain and often contradictory notices handed down to us of their tenets, to have been far more alive, and less warped by a vain and arrogant turn, than at a later period." For the question of the old Philosophers see infr. I. 96—98.

47 This is one of the absurd fallacies arising from the use of Analogies, into which Bacon (when his feelings outrun his judgment) is prone to fall. He seemed to like the

immunes erant: sed in ambitionem et vanitatem sectæ condendæ, et auræ popularis captandæ, nimium propendebant. Pro desperata autem habenda est veritatis inquisitio, cum ad hujusmodi inania deflectat. Etiam non omittendum videtur judicium illud, sive vaticinium potius, sacerdotis Ægyptii de Græcis: *Quod semper pueri essent; neque haberent antiquitatem scientiæ, aut scientiam antiquitatis*[48]. Et certe habent id quod puerorum est; ut ad garriendum prompti sint, generare autem non possint: nam verbosa videtur sapientia eorum, et operum sterilis. Itaque ex ortu et gente philosophiæ, quæ in usu est, quæ capiuntur signa, bona non sunt.

LXXII.

Neque multo meliora sunt signa, quæ ex natura temporis et ætatis capi possunt, quam quæ ex natura loci et nationis[49]. Angusta enim erat et tenuis notitia per illam ætatem vel temporis vel orbis: quod longe pessimum est, præsertim iis qui omnia in experientia ponunt. Neque enim mille annorum historiam, quæ digna erat nomine historiæ, habebant; sed fabulas et rumores antiquitatis. Regionum vero tractuumque mundi exiguam partem noverant; cum omnes hyperboreos, Scythas; omnes occidentales, Celtas indistincte appellarent: nil in Africa ultra citimam Æthiopiæ partem, nil in Asia ultra Gangem; multo minus novi

argument, as it occurs again in a few pages. (I. 77); as also in the Adv. of Learning, p. 49; and in the Filum Labyr. § 8.

48 This saying is from Plato, Timæus 22 b. Ὦ Σόλων, Σόλων, Ἕλληνες ἀεὶ παῖδές ἐστε· γέρων δὲ Ἕλλην οὐκ ἔστιν· —— οὐδεμίαν γὰρ ἐν ταῖς ψυχαῖς ἔχετε δι' ἀρχαίαν ἀκοὴν παλαιὰν δόξαν οὐδὲ μάθημα χρόνῳ πολιὸν οὐδέν. It is also given in the Adv. of Learning, p. 58.

49 Cf. infr. I. 84. This ignorance of the regions of the globe would not seem so great an evil at first sight; but all true geognosy and astronomy depend on a knowledge of the (proximately) spherical shape of the globe. And certainly the growth of all knowledge seemed to be attached very closely to the progress of discovery in the 15th and 16th centuries.

orbis provincias, ne per auditum sane aut famam aliquam certam et constantem, nossent: imo et plurima climata et zonæ, in quibus populi infiniti spirant et degunt, tanquam inhabitabiles ab illis pronuntiata sint: quinetiam peregrinationes Democriti, Platonis, Pythagoræ[50], non longinquæ profecto, sed potius suburbanæ, ut magnum aliquid celebrarentur. Nostris autem temporibus, et novi orbis partes complures, et veteris orbis extrema undique innotescunt; et in infinitum experimentorum cumulus excrevit. Quare si ex nativitatis aut genituræ tempore (astrologorum more) signa capienda sint, nil magni de istis philosophiis significari videtur.

LXXIII.

Inter signa, nullum magis certum aut nobile est, quam quod ex fructibus. Fructus enim et opera inventa pro veritate philosophiarum velut sponsores et fidejussores sunt. Atque ex philosophiis istis Græcorum, et derivationibus earum per particulares sciëntias, jam per tot annorum spatia, vix unum experimentum adduci potest, quod ad hominum statum levandum et juvandum spectet, et philosophiæ speculationibus ac dogmatibus vere acceptum referri possit. Idque Celsus[51] ingenue ac prudenter fatetur; nimirum, experimenta medicinæ primo inventa fuisse, ac postea homines circa ea philosophatos esse, et causas indagasse et

[50] The travels of Democritus reached over a great part of Asia, and some state that he even reached India and Æthiopia. Those of Plato extended only to Sicily, Egypt, and Cyrene. Those of Pythagoras to Egypt, Arabia, Phœnicia, Babylon, and possibly India.

[51] *Celsus*, the Physician, probably lived at the beginning of the Christian era. He followed (to a great extent) the Hippocratic method of observing and watching over the operations of Nature, regulating rather than opposing them. The ancient system of Medicine was an epitome of the Scholastic evils which in the middle ages afflicted all sciences; so that even where experiment was necessary, men succeeded in rendering it almost fruitless.

assignasse; non ordine inverso evenisse, ut ex philosophia et causarum cognitione, ipsa experimenta inventa aut deprompta essent. Itaque mirum non erat, apud Ægyptios (qui rerum inventoribus divinitatem et consecrationem attribuerunt) plures fuisse brutorum animalium imagines, quam hominum: quia bruta animalia, per instinctus naturales, multa inventa pepererunt; ubi homines, ex sermonibus et conclusionibus rationalibus, pauca aut nulla exhibuerint.

At chemicorum industria[51] nonnulla peperit; sed tanquam fortuito et obiter, aut per experimentorum quandam variationem, (ut mechanici solent) non ex arte aut theoria aliqua; nam ea, quam confinxerunt, experimenta magis perturbat, quam juvat. Eorum etiam, qui in magia (quam vocant) naturali versati sunt, pauca reperiuntur inventa; eaque levia, et imposturæ propiora. Quocirca, quemadmodum in religione cavetur, ut fides ex operibus monstretur; idem etiam ad philosophiam optime traducitur, ut ex fructibus judicetur, et vana habeatur quæ sterilis sit: idque eo magis, si loco fructuum uvæ et olivæ, producat disputationum et contentionum carduos et spinas[52].

LXXIV.

Capienda etiam sunt signa ex incrementis et progressibus philosophiarum et scientiarum. Quæ enim

[51] To them we owe alcohol, aquafortis, vitriolic acid, volatile alkali, gunpowder, and other discoveries; by no means despicable, though not to be compared with those which we have since arrived at by the regular progress of Modern Chemistry. See Sir W. Herschel's Discourse on Nat. Phil. § 103.

[52] Allusion to St. Luke vi. 42, 43. Dugald Stewart Phil. of the Human Mind, part II. chap. iv. § 1. (note) quotes part of this Aphorism with great approbation; for it points out one essential distinction between Ancient and Modern Physics—i. e. the absence in the former of any *experiment*: *observation* they had, as may be seen universally in Aristotle; but the torture of Nature by experiment they did not venture upon. Consequently their discoveries might be curious, but were useless and barren of fruit for the promotion of human happiness.

in natura fundata sunt, crescunt et augentur: quæ autem in opinione, variantur, non augentur. Itaque si istæ doctrinæ plane instar plantæ a stirpibus suis revulsæ non essent, sed utero naturæ adhærerent, atque ab eadem alerentur, id minime eventurum fuisset, quod per annos bis mille jam fieri videmus: nempe, ut scientiæ suis hæreant vestigiis, et in eodem fere statu maneant, neque augmentum aliquod memorabile sumpserint; quin potius in primo auctore maxime floruerint, et deinceps declinaverint. In artibus autem mechanicis, quæ in natura et experientiæ luce fundatæ sunt, contra evenire videmus: quæ (quamdiu placent) veluti spiritu quodam repletæ, continuo vegetant et crescunt; primo rudes, deinde commodæ, postea excultæ, et perpetuo auctæ.

LXXV.

Etiam aliud signum capiendum est; (si modo signi appellatio huic competat; cum potius testimonium sit, atque adeo testimoniorum omnium validissimum;) hoc est, propria confessio auctorum, quos homines nunc sequuntur. Nam et illi, qui tanta fiducia de rebus pronuntiant, tamen per intervalla, cum ad se redeunt, ad querimonias de naturæ subtilitate, rerum obscuritate, humani ingenii infirmitate, se convertunt[58]. Hoc vero si simpliciter fieret, alios fortasse, qui sunt timidiores, ab ulteriori inquisitione deterrere, alios vero, qui sunt ingenio alacriori et magis fidenti, ad ulteriorem progressum acuere et incitare possit. Verum non satis illis est, de se confiteri, sed quicquid sibi ipsis aut magistris suis incognitum aut intactum fuerit, id extra terminos possibilis ponunt; et tanquam ex arte cognitu

[58] See the beginning of Dr. Jeremie's essay on the Sceptical Philosophy in the Encycl. Metr. "From the earliest ages of Philosophy we may remark a frequent expression of doubt, bordering on despondency, in the language of its most distinguished followers."

aut factu impossibile pronuntiant: summa superbia et invidia suorum inventorum infirmitatem in naturæ ipsius calumniam, et aliorum omnium desperationem vertentes. Hinc schola Academiæ novæ[54], quæ *acatalepsiam* ex professo tenuit, et homines ad sempiternas tenebras damnavit. Hinc opinio, quod formæ sive veræ rerum differentiæ (quæ revera sunt leges actus puri[55]) inventu impossibiles sint, et ultra hominem. Hinc opiniones illæ in activa et operativa parte: calorem solis et ignis toto genere differre; ne scilicet homines putent se per opera ignis aliquid simile iis, quæ in natura fiunt, educere et formare posse. Hinc illud: compositionem tantum opus hominis, mistionem vero opus solius naturæ esse; ne scilicet homines sperent aliquam ex arte corporum naturalium generationem aut transformationem. Itaque ex hoc signo homines sibi persuaderi facile patientur, ne cum dogmatibus non solum desperatis, sed etiam desperationi devotis, fortunas suas et labores misceant.

LXXVI.

Neque illud signum prætermittendum est, quod tanta fuerit inter philosophos olim dissensio, et scholarum ipsarum varietas: quod satis ostendit, viam a sensu ad intellectum non bene munitam fuisse, cum eadem materia philosophiæ (natura scilicet rerum) in tam vagos et multiplices errores abrepta fuerit et distracta. Atque licet hisce temporibus dissensiones et dogmatum diversitates circa principia ipsa, et philosophias integras, ut plurimum extinctæ sint; tamen circa partes philosophiæ, innumeræ manent quæstiones et controversiæ; ut plane appareat, neque in philosophiis ipsis, neque in modis demonstrationum aliquid certi aut sani esse.

54 Cf. supr. I. 67.

55 Cf. supr. I. 51.

LXXVII.

Quod vero putant homines, in philosophia Aristotelis magnum utique consensum esse; cum post illam editam, antiquorum philosophiæ cessaverint et exoleverint; ast apud tempora, quæ sequuta sunt, nil melius inventum fuerit; adeo ut illa tam bene posita et fundata videatur, ut utrumque tempus ad se traxerit: primo, quod de cessatione antiquarum philosophiarum post Aristotelis opera edita homines cogitant, id falsum est; diu enim postea, usque ad tempora Ciceronis, et secula sequentia, manserunt opera veterum philosophorum[56]. Sed temporibus insequentibus, ex inundatione Barbarorum in imperium Romanum, postquam doctrina humana velut naufragium perpessa esset; tum demum philosophiæ Aristotelis et Platonis, tanquam tabulæ ex materia leviore et minus solida, per fluctus temporum servatæ sunt[57]. Illud etiam de consensu fallit homines, si acutius rem introspiciant. Verus enim consensus is est[58], qui ex libertate judicii (re prius explorata) in idem conveniente consistit. At

[56] And not only the works of Bacon's favourites, the older Greek Philosophers, but the Stoic and Epicurean Schools existed, as did also the Neo-Platonists.

[57] Cf. supr. I. 71.

[58] The true rule of consent then will be, if men agree after (1) careful investigation; (2) free judgment: free, i.e. from trammels of authority, prejudice, suspicion, &c. Aristotle himself gives a rule for 'consent' which is extremely judicious, *τὰ πᾶσιν ἢ τοῖς πλείστοις ἢ τοῖς μάλιστα γνωρίμοις δοκοῦντα*, Ar. Topic. I. i. 7. shewing that there is a strong presumption in favour of whatever is believed by everybody; or by those who have particularly studied the subject in question. All men must judge of some rudimentary points of moral and social life: for all have to do with them: but it is only the *γνώριμοι* whose judgment is worth any thing as to subjects beyond vulgar apprehension. Thus the universal consent of five thousand years and more in the sun's revolving round the earth, has now no weight at all. Aristotle was quite aware too of the risk arising to truth from custom: see Metaph. A. *τὸ ἔλαττον*, ch. 3. *Ἡλίκην δὲ ἰσχὺν ἔχει τὸ σύνηθες, οἱ νόμοι δηλοῦσιν, ἐν οἷς τὰ μυθώδη καὶ παιδαριώδη μεῖζον ἰσχύει τοῦ γινώσκειν περὶ αὐτῶν διὰ τὸ ἔθος.*

numerus longe maximus eorum, qui in Aristotelis philosophiam consenserunt, ex præjudicio et auctoritate aliorum se illi mancipavit; ut sequacitas sit potius et coitio, quam consensus. Quod si fuisset ille verus consensus et late patens, tantum abest ut consensus pro vera et solida auctoritate haberi debeat, ut etiam violentam præsumptionem inducat in contrarium. Pessimum enim omnium est augurium, quod ex consensu capitur in rebus intellectualibus: exceptis divinis et politicis, in quibus suffragiorum jus est[58]. Nihil enim multis placet, nisi imaginationem feriat, aut intellectum vulgarium notionum nodis astringat, ut supra[59] dictum est. Itaque optime traducitur illud Phocionis[60] a moribus ad intellectualia: *Ut statim se examinare debeant homines, quid erraverint aut peccaverint,*

[58] As to Politics, this is rather a bold doctrine from one who sought the favour of King James I., and was an advocate for "Kingcraft." Yet it is not a solitary mention of the "jus suffragii" even in those times. Hooker points out (Eccles. Pol. I. x. 38) that Laws positive and Municipal are binding only by consent of those subject to them. And in our day we are well accustomed to the principle of ultimately consulting the Ratepayer. But as to the "jus suffragii" ruling in things Divine, this would at first seem to strike at any thing like absolute Truth, or Revelation: as though the truth of God depended for its existence on Man's acceptance of it. Bacon, however, doubtless refers to the decisions of Councils, in which questions of doctrine and discipline are decided by an appeal to the suffrages of those present; even as the Council of Nice affirmed the true Faith against Arianism by a majority of votes.

[59] Supra cf. supr. I. 28.

[60] Here we see Phocion's Character —μισόδημος. And what, after all, is the worth of the verdict of Public Opinion? Not much, perhaps, if we take Public Opinion of one period only: for man must be misguided by partial views, passions, &c. And a man who trusts to and courts it is unfortunate.

"Cum quis te laudat, judex tuus esse memento:
Plus aliis de te, quam tu tibi credere noli." Dion. Cato.

He who seeks the applause of Public Opinion will be the *Vain* man: he who despises it, *Proud*. I may add that it is always correcting itself: and that its hastier verdicts are always being called in. Seneca agreed well with Phocion when he said, "Argumentum pessimi turba est." Cf. Plutarch. vit. Phoc.

si multitudo consentiat et complaudat. Hoc signum igitur ex aversissimis est. Itaque quod signa veritatis et sanitatis philosophiarum et scientiarum, quæ in usu sunt, male se habeant; sive capiantur ex originibus ipsarum, sive ex fructibus, sive ex progressibus, sive ex confessionibus auctorum, sive ex consensu; jam dictum est.

LXXVIII.

Jam vero veniendum ad caussas errorum, et tam diuturnæ in illis per tot secula moræ; quæ plurimæ sunt et potentissimæ: ut tollatur omnis admiratio, hæc, quæ adducimus, homines hucusque latuisse et fugisse; et maneat tantum admiratio, illa nunc tandem alicui mortalium in mentem venire potuisse, aut cogitationem cujuspiam subiisse: quod etiam (ut nos existimamus) felicitatis magis est cujusdam, quam excellentis alicujus facultatis; ut potius pro temporis partu haberi debeat, quam pro partu ingenii[61].

Primo autem tot seculorum numerus, vere rem reputanti, ad magnas angustias recidit. Nam ex viginti quinque annorum centuriis, in quibus memoria et doctrina hominum fere versatur, vix sex centuriæ seponi et excerpi possunt, quæ scientiarum feraces, earumve proventui utiles fuerunt[62]. Sunt enim non

[61] See Playfair's Dissert. Encycl. Brit. vol. I. p. 453. Speaking of the causes of failure among the ancients, he says, "Men had not acquired the power over that light (of experience) which now enables them to concentrate its beams, and to fix them steadily on whatever objects they wished to examine. This power is what distinguishes modern Physics; and is the cause why later Philosophers, without being more ingenious than their predecessors, have been infinitely more successful in their study of Nature."

How far was it Humility (as some have said) which led Bacon to call the Nov. Org. "partus temporis?" —one recollects that in his younger days he spoke of it as the "partus temporis *maximus*"—with what seems a different sense from that given here. Cf. infr. I. 122. See also the commencement of the Dedication to King James.

[62] Does not Bacon narrow the periods overmuch? He neglects

minus temporum quam regionum eremi et vastitates. Tres enim tantum doctrinarum revolutiones et periodi recte numerari possunt: una, apud Græcos; altera, apud Romanos; ultima, apud nos, occidentales scilicet Europæ nationes: quibus singulis vix duæ centuriæ annorum merito attribui possunt. Media mundi tempora, quoad scientiarum segetem uberem aut lætam, infelicia fuerunt. Neque enim causa est ut vel Arabum vel scholasticorum mentio fiat: qui per intermedia tempora scientias potius contriverunt numerosis tractatibus, quam pondus earum auxerunt. Itaque prima causa tam pusilli in scientiis profectus ad angustias temporis erga illas propitii rite et ordine refertur.

LXXIX.

At secundo loco se offert causa illa magni certe per omnia momenti: ea videlicet, quod per illas ipsas ætates, quibus hominum ingenia et literæ maxime vel etiam mediocriter floruerint, naturalis philosophia minimam partem humanæ operæ sortita sit. Atque hæc ipsa nihilominus pro magna scientiarum matre haberi debet. Omnes enim artes et scientiæ, ab hac stirpe revulsæ, poliuntur fortasse, et in usum effinguntur; sed nil admodum crescunt. At manifestum est, postquam Christiana fides recepta fuisset et adolevisset, longe maximam ingeniorum præstantissimorum partem ad theologiam se contulisse; atque huic rei et amplissima præmia proposita, et omnis generis adjumenta copiosissime subministrata fuisse: atque hoc theologiæ stu-

Indian philosophy; though it attained very considerable note: and two centuries for Greece and two for Rome seem very little. What a vast difference printing makes in this respect! its "Experientia literata," we are wont to believe, can never be lost: and so mankind can never again fall from its discoveries or its civilization. For the want of originality in the Arabian Philosophers mentioned below see Gibbon's Decline and Fall, chap. 52.

dium præcipue occupasse tertiam illam partem sive periodum temporis apud nos Europæos occidentales; eo magis, quod sub idem fere tempus et literæ florere, et controversiæ circa religionem pullulare cœperint[63]. At ævo superiori, durante periodo illa secunda, apud Romanos potissimæ philosophorum meditationes et industriæ in morali philosophia (quæ ethnicis vice theologiæ erat[64]) occupatæ et consumptæ fuerunt: etiam

[63] Bacon here takes the three periods backwards, and points out how Natural Philosophy has come to be neglected in each. (1) In the Christian Period by the engrossing effects of the questions connected with Revelation; the rule of Faith, and the spiritual Nature and needs of man. (2) In the Roman Period by the study of Morals, and the requirements of the political state, which naturally engrossed much of the Roman citizen's thoughts. (3) And lastly in the Greek (although here for a time there was some study of Nature) by the preference here also shewn for questions of morals. And need it be wondered at, that these subjects—God's will in the Christian Period, and man's constitution in the Heathen—should be all-engrossing? Is it not from these two that men hope to discover the secret of Happiness, for which all live? And to what avail would be the study of Physics, if it allowed a deterioration of Morals? Among mankind the study of Physics must always be the heritage of a few. The mass of people can only be expected to use the results got at by the skill of others. And if we take all Physical Philosophy, (including Astronomy, which Bacon would probably have omitted,) we cannot but see that the vast majority of men are unfit, unable to investigate the "veritas" involved in it; though all can be benefited by its "utilitas." Among the errors of Bacon, we must count his belief that the study of Physics would produce a levelling of men's intellect, and that all would be able to enter upon it equally well. The very contrary to this is the case.

[64] Moral Philosophy was the Religion of the Ancients. Without revelation, and the Christian dispensation, they could know nothing of things Spiritual. Their *θεῖον ἐν ἀνθρώπῳ* was the cold pure Intellect: and that which led to truth of life and conduct for the multitude was Moral Philosophy and Legislation. The "Cultus" of the Ancients had little or nothing to do with purity of personal behaviour, or the sanctity of social ties. The Priesthood did not teach—(except when, as in the case of Pyrrho the Sceptic, it chanced that a Philosopher was elected Priest—) to impart knowledge was no part of its functions. Religion among the Ancients was confined to the performance of certain sacrifices, public or private, according to rules handed down from father to son. So it came that Moral Philosophy and Law were entirely distinct from Religion. With us Religion includes both their "Cultus" and their moral and other teaching, while Law is placed under

summa ingenia illis temporibus ut plurimum ad res civiles se applicuerunt, propter magnitudinem imperii Romani, quod plurimorum hominum opera indigebat. At illa ætas, qua naturalis philosophia apud Græcos maxime florere visa est, particula fuit temporis minime diuturna; cum et antiquioribus temporibus septem illi, qui sapientes nominabantur, omnes (præter Thaletem) ad moralem philosophiam et civilia se applicuerint; et posterioribus temporibus, postquam Socrates philosophiam de cœlo in terras deduxisset[65], adhuc magis invaluerit moralis philosophia, et ingenia hominum a naturali averterit.

At ipsissima illa periodus temporis, in qua inquisitiones de natura viguerunt, contradictionibus et novorum placitorum ambitione corrupta est, et inutilis reddita. Itaque quandoquidem per tres istas periodos naturalis philosophia majorem in modum neglecta aut impedita fuerit, nil mirum si homines parum in ea re profecerint, cum omnino aliud egerint.

LXXX.

Accedit et illud, quod naturalis philosophia in iis ipsis viris, qui ei incubuerint, vacantem et integrum hominem, præsertim his recentioribus temporibus, vix

the hands of the civil power. Their Law, again, enjoined *τί δεῖ πράττειν καὶ τινῶν ἀπέχεσθαι*, having a positive as well as a negative side. For their "State" was also their "Church." With us the positive precepts are left to Religion; and Law now is almost restricted to the prohibitive side—"Quæ lex non jubet, permittit:" with the ancients, as Aristotle says, *ὃ ὁ νόμος μὴ κελεύει, ἀπαγορεύει*. See Bacon's Filum Labr. § 6.

[65] In so far as Socrates endeavoured to replace the subtle talk on abstract questions, and the quibbling of the teachers of his day, by the study of human life and its interests, there was a kind of analogy between him and Bacon. The thought comes from Cicero's Tusc. Disp. V. iv. 10. "Socrates primus Philosophiam devocavit e cœlo, et in urbibus collocavit, et in domos etiam introduxit, et coegit de vita et moribus rebusque bonis et malis quærere."

nacta sit; nisi forte quis monachi alicujus in cellula, aut nobilis in villula lucubrantis, exemplum adduxerit[66]: sed facta est demum naturalis philosophia instar transitus cujusdam et pontisternii ad alia.

Atque magna ista scientiarum mater mira indignitate ad officia ancillæ detrusa est; quæ medicinæ aut mathematices operibus ministret, et rursus quæ adolescentium immatura ingenia lavet et imbuat velut tinctura quadam prima, ut aliam postea felicius et commodius excipiant. Interim nemo expectet magnum progressum in scientiis, (præsertim in parte earum operativa) nisi philosophia naturalis ad scientias particulares producta fuerit, et scientiæ particulares rursus ad naturalem philosophiam reductæ. Hinc enim fit, ut astronomia, optica, musica, plurimæ artes mechanicæ, atque ipsa medicina, atque (quod quis magis miretur) philosophia moralis et civilis, et scientiæ logicæ, nil fere habeant altitudinis in profundo; sed per superficiem et varietatem rerum tantum labantur: quia postquam particulares istæ scientiæ dispertitæ et constitutæ fuerint, a philosophia naturali non amplius aluntur; quæ ex fontibus et veris contemplationibus motuum, radiorum, sonorum, texturæ, et schematismi corporum, affectuum, et prehensionum intellectualium, novas vires et augmenta illis impertiri potuerit[67]. Ita-

[66] This Monk in his cell doubtless refers to Roger Bacon in his study at Oxford; see Palgrave, Merchant and Friar: and the Noble in his Villa is probably Descartes.

[67] For this dependence of our knowledge in Morals and Logic as well as Mechanics, or Mathematics, on Natural Philosophy, see infr. I. 127. This is one of the Aphorisms which seem to favour the doctrine that Bacon was a "Positivist;" as shewing that he considered the causes of moral good and evil to be material. But there is no ground whatever for this. Our affections &c. must act in a material body, and so, to a certain extent, have physical phenomena; and, therefore, so far are under the head of Natural Philosophy: but there is nothing to shew that Bacon meant more than this. The materialist system of Morals and habits is well attacked by

que minime mirum est, si scientiæ non crescant, cum a radicibus suis sint separatæ.

LXXXI.

Rursus se ostendit alia causa potens et magna, cur scientiæ parum promoverint. Ea vero hæc est; quod fieri non possit, ut recte procedatur in curriculo, ubi ipsa meta non recte posita sit et defixa. Meta autem scientiarum vera et legitima non alia est quam ut dotetur vita humana novis inventis et copiis[68]. At

D. Stewart, Phil. of the Human Mind, part I. chap. ii. on Attention.

[68] This Aphorism gives us the key to the chief part of Bacon's Philosophy; not "quæstiones" but "fructus;" and that not immediate and partial, but permanent and complete. "Lord Bacon," says D. Stewart (Phil. of the Human Mind, Introd. II. § 2), "was the first person who took this comprehensive view of the different departments of study: and who pointed out, to all classes of literary men, the great end to which all their labours should conspire; the multiplication of the sources of human enjoyment, and the extension of man's dominion over Nature." See De Augm. Scient. i. "Omnium autem gravissimus error in deviatione ab ultimo doctrinarum fine consistit. Appetunt enim homines Scientiam, alii ex invita curiositate et irrequieta; alii animi causa et delectationis; alii existimationis gratia; alii contentionis ergo, atque ut in disserendo superiores sint: plerique propter lucrum et victum: paucissimi, ut donum rationis, divinitus datum, in usus humani generis impendant.—Hoc enim illud est, quod revera doctrinam atque artes condecoraret et attolleret, si contemplatio et actio arctiore quam adhuc vinculo copularentur." In the Adv. of Learning, Bk. i, he makes the true end of Science "the relief of man's estate." The danger of carrying out to the full this principle will be that we are always liable to follow after "material gratification" at the expense of all else. And yet the most comfortable person will (ceteris paribus) be the most healthy; that is, mere exposure and hardship never strengthen. Comfort, cleanliness, and vigour go together. If we worship enjoyment, make a science of it, seek life (as it were) for its sake, the result must be lowering. But comfort in itself is no enemy to strength. Some would have it that Morality at least (if not Faith too) consists in Good Taste—another phase of the same belief. There is a connection, a close analogy, between the beautiful of Art and Education, and the beautiful of Moral Life: but they can be disjoined; and so can the comfortable and the good. Still "Utility and Progress" are great ends for man's social life, and will (like all God's gifts), if rightly used, be found subservient to Religion. At any rate a man who lives (for example) in a comfortable cottage will have more self-respect, and fewer social annoyances, than if his

turba longe maxima nihil ex hoc sapit, sed meritoria plane est, et professoria; nisi forte quandoque eveniat, ut artifex aliquis acrioris ingenii, et gloriæ cupidus, novo alicui invento det operam; quod fere fit cum facultatum [69] dispendio. At apud plerosque tantum abest, ut homines id sibi proponant, ut scientiarum et artium massa augmentum obtineat; ut ex ea, quæ præsto est, massa nil amplius sumant aut quærant, quam quantum ad usum professorium, aut lucrum, aut existimationem, aut hujusmodi compendia, convertere possint. Quod si quis ex tanta multitudine scientiam affectu ingenuo et propter se expetat; invenietur tamen ille ipse potius contemplationum et doctrinarum varietatem, quam veritatis severam et rigidam inquisitionem sequi. Rursus, si alius quispiam fortasse veritatis inquisitor sit severior; tamen et ille ipse talem sibi proponet veritatis conditionem, quæ menti et intellectui satisfaciat in redditione causarum rerum quæ jampridem sunt cognitæ; non eam, quæ nova operum pignora, et novam axiomatum lucem assequatur. Itaque, si finis scientiarum a nemine adhuc bene positus sit, non mirum est, si in iis, quæ sunt subordinata ad finem, sequatur aberratio.

LXXXII.

Quemadmodum autem finis et meta scientiarum male posita sunt apud homines; ita rursus etiam si

home were filthy and wretched; and nothing is so favourable to vice as the prostration springing from bad food, bad air, and dirt. And self-respect is both good in itself, and leads to a moral life and to a greater readiness to receive religious impressions. And Education, though its development, often too rapid and superficial, sometimes leads to mental Infidelity, is at any rate better than ignorance and degradation, which are after all a kind of brutish Infidelity. Macaulay in his Essay on Bacon refers to this Aphorism. His Essay has a worldly and material tendency throughout (visible, for instance, in his unjust attack on Plato), which is to be regretted. Cf. also infra I. 116.

[69] Facultates, δυνάμεις, Property.

illa recte posita fuissent, viam tamen sibi delegerunt omnino erroneam et imperviam. Quod stupore quodam animum rite rem reputanti perculserit; non ulli mortalium curæ aut cordi fuisse, ut intellectui humano ab ipso sensu et experientia ordinata et bene condita via aperiretur et muniretur; sed omnia vel traditionum caligini, vel argumentorum vertigini et turbini, vel casus et experientiæ vagæ et inconditæ undis et ambagibus, permissa esse. Atque cogitet quis sobrie et diligenter, qualis sit ea via, quam in inquisitione et inventione alicujus rei homines adhibere consueverunt. Et primo notabit proculdubio inveniendi modum simplicem et inartificiosum, qui hominibus maxime est familiaris[70]. Hic autem non alius est, quam ut is, qui se ad inveniendum aliquid comparat et accingit, primo quæ ab aliis circa illa dicta sint inquirat et evolvat; deinde propriam meditationem addat, atque per mentis multam agitationem, spiritum suum proprium sollicitet, et quasi invocet, ut sibi oracula pandat: quæ res omnino sine fundamento est, et in opinionibus tantum volvitur.

At alius quispiam dialecticam[71] ad inveniendum advocet, quæ nomine tenus tantum ad id quod agitur pertinet. Inventio enim dialecticæ non est principiorum et axiomatum præcipuorum, ex quibus artes constant, sed eorum tantum, quæ illis consentanea videntur. Dialectica enim magis curiosos et importunos, et sibi negotium facessentes, eamque interpellantes de probationibus et inventionibus principiorum, sive axio-

70 (1) This error in the means used for discovery of Truth, is the trusting to Authorities, rather than appealing to facts. Of this Aristotle was a notable instance. With him the investigation of the opinions of others was one form of Induction.

71 (2) This error is utterly vicious. Dialectics in themselves can never be of the slightest use in Discovery.

matum primorum, ad fidem, et veluti sacramentum cuilibet arti præstandum, notissimo responso rejicit.

Restat experientia mera[72]: quæ, si occurrat, casus; si quæsita sit, experimentum nominatur. Hoc autem experientiæ genus nihil aliud est, quam (quod aiunt) scopæ dissolutæ[73], et mera palpatio, quali homines noctu utuntur, omnia pertentando, si forte in rectam viam incidere detur; quibus multo satius et consultius foret, diem præstolari, aut lumen accendere, et deinceps viam inire. At contra, verus experientiæ ordo primo lumen accendit, deinde per lumen iter demonstrat, incipiendo ab experientia ordinata et digesta, et minime præpostera[74] aut erratica, atque ex ea educendo axiomata, atque ex axiomatibus constitutis rursus experimenta nova, quum nec verbum divinum in rerum massam absque ordine operatum sit.

Itaque desinant homines mirari, si spatium scientiarum non confectum sit, cum a via omnino aberraverint; relicta prorsus et deserta experientia, aut in ipsa (tanquam in labyrintho) se intricando, et circumcursando; cum rite institutus ordo per experientiæ sylvas[75] ad aperta axiomatum tramite constanti ducat.

72 (3) This error, of disorderly experience, probably is put here as against Aristotle's collections of facts in Natural History. But if we take Bacon's Sylva Sylvarum as a specimen of *his* style of collection, what order is there even in his own catalogues?

73 "scopæ dissolutæ." The translators have missed the meaning here. One translates—but what it means is a mystery—"shooting at rovers." Wood has "a loose fagot:" which, though not wrong, is not explicit. It is a proverb—Cicero uses it of Cæsar, "L. Cæsarem vidi Minturnis—non hominem sed *scopas dissolutas*," Ad Att. 7. 13. It is used of any one or any thing vain or futile. Here of experiments heaped together without any order, just like the twigs of an unbound besom. Cf. I. 101, 102. It probably is an allusion to Æsop's fable of the bundle of sticks.

74 "præpostera" *ὕστερον πρότερον*, i. e. making up one's mind first, and finding examples to suit afterwards.

75 Bacon is fond of this Metaphor. It is only partly good. The tanglewood and thick trees of pathless experience unarranged—so far all well:

LXXXIII.

Excrevit autem mirum in modum istud malum ex opinione quadam, sive æstimatione inveterata, verum tumida et damnosa; minui nempe mentis humanæ majestatem, si experimentis, et rebus particularibus sensui subjectis, et in materia determinatis, diu ac multum versetur[76]: præsertim quum hujusmodi res ad inquirendum laboriosæ, ad meditandum ignobiles, ad dicendum asperæ, ad practicam illiberales, numero infinitæ, et subtilitate tenues esse soleant. Itaque jam tandem huc res rediit, ut via vera non tantum deserta, sed etiam interclusa et obstructa sit; fastidita experientia, nedum relicta, aut male administrata.

LXXXIV.

Rursus vero homines a progressu in scientiis detinuit et fere incantavit reverentia antiquitatis, et virorum, qui in philosophia magni habiti sunt, auctoritas, atque deinde consensus. Atque de consensu superius dictum est[77].

De antiquitate[78] autem opinio, quam homines de ipsa

but what is wanted is not a path out of a wood into open country, so much as a good arrangement of the trees in it. The Metaphor is expanded in a fragment supposed to be his Introduction to the Fourth fact of the Instauration; there, speaking of the Sylv. Sylv., he says, "we endeavoured to penetrate and pass through the woods of Nature, thick set and darkened with a great variety of experiments, as with leaves; and entangled and twined together, like shrubs and bushes, with the subtilty of observations. We are now, perhaps, proceeding to the more open parts of Nature, which however are still more difficult; and having got through the woods, are come to the bottoms of the mountains:" and so on.

[76] Something like this contempt of particulars will be traced in many of the Ancient Philosophers — in such doctrines (for example) as that the "ἄπειρον" is κακόν. So too in Plato Rep. Bk. vii. on Education. Roger Bacon in the Opus Majus I. ix. says that the contempt for what one does not know is one chief hindrance to improvement.

[77] superius—viz. I. 77.

[78] Cf. Adv. of Learning, Bk. i. p. 47, 48. Almost all the opening of Roger Bacon's Opus Majus battles with the prejudice in favour of Antiquity. Opus Majus, I. i.—viii. See also the Introd. to Locke's

fovent, negligens omnino est, et vix verbo ipsi congrua. Mundi enim senium et grandævitas pro antiquitate vere habenda sunt; quæ temporibus nostris tribui debent, non juniori ætati mundi, qualis apud antiquos fuit. Illa enim ætas, respectu nostri, antiqua et major; respectu mundi ipsius, nova et minor fuit. Atque revera quemadmodum majorem rerum humanarum notitiam, et maturius judicium, ab homine sene expectamus, quam a juvene, propter experientiam, et rerum, quas vidit, et audivit, et cogitavit, varietatem et copiam; eodem modo et a nostra ætate (si vires suas nosset, et experiri et intendere vellet) majora multo quam a priscis temporibus expectari par est; utpote ætate mundi grandiore, et infinitis experimentis et observationibus[79] aucta et cumulata.

Neque pro nihilo æstimandum, quod per longinquas navigationes et peregrinationes (quæ seculis nostris increbuerunt) plurima in natura patuerint, et reperta sint, quæ novam philosophiæ lucem immittere possint. Quin et turpe hominibus foret, si globi materialis tractus, terrarum videlicet, marium, astrorum, nostris temporibus immensum aperti et illustrati sint; globi autem intellectualis finis inter veterum inventa et angustias cohibeantur.

Essay on Human Understanding. Cf. also Hooker's Eccles. Pol. V. 7. 1.

Seneca also had the notion of the later times being really the older; and is quoted to that effect in the Opus Majus, i. 9. "Antiquitas seculi juventus mundi."

[79] Experiment and Observation—their relative worth and application. See Sir W. Herschel's Discourse, § 67. Mill's Logic, book III. ch. vii. Coleridge's Table-Talk, Oct. 8, 1830. "Personal Experiment is necessary in order to correct our own Observations of the Experiments which Nature herself makes for us—I mean, the Phenomena of the Universe. But then Observation is, in turn, wanted to direct and substantiate the course of Experiment. Experiments alone cannot advance knowledge without Observation; they amuse for a time, and then pass off the scene and leave no trace behind them."

Auctores vero quod attinet[80], summæ pusillanimitatis est, auctoribus infinita tribuere, auctori autem auctorum, atque adeo omnis auctoritatis, tempori, jus suum denegare. Recte enim veritas temporis filia dicitur, non auctoritatis. Itaque mirum non est, si fascina ista antiquitatis, et auctorum, et consensus, hominum virtutem ita ligaverint, ut cum rebus ipsis consuescere (tanquam maleficiati) non potuerint.

LXXXV.

Neque solum admiratio antiquitatis, auctoritatis, et consensus, hominum industriam in iis, quæ jam inventa sunt, acquiescere compulit; verum etiam operum ipsorum admiratio, quorum copia jampridem facta est humano generi. Etenim quum quis rerum varietatem, et pulcherrimum apparatum, qui per artes mechanicas[81] ad cultum humanum congestus et introductus est, oculis subjecerit, eo certe inclinabit, ut potius ad opulentiæ humanæ admirationem, quam ad inopiæ sensum accedat; minime advertens primitivas hominis observationes, atque naturæ operationes, (quæ ad omnem illam varietatem instar animæ sunt, et primi motus) nec multas, nec alte petitas esse; cætera ad patientiam hominum tantum, et subtilem et ordinatum manus vel

[80] Man's love of rest (referred to I. 20) would readily lead him to acquiesce in the judgments of others. Besides this there is our crush of work, which produces in us a habit of taking statements on trust—so introducing the "division of labour" principle—a principle which helps things on, but has a very narrowing effect on men's minds: then there is veneration, and humble distrust of self—a good quality with a bad tendency (and what good quality has not such?). And after all, "Truth is the child of Time:" but is not Time here (to a great extent) revised and rectified Authority? Just as is the case with Consent, which is perhaps also a form of Authority. If men were perfect there might be no need of it: but as we are we seem to require guides. What Bacon is opposing is idle trusting in others, instead of verifying statements; and appealing to men, instead of to facts.

[81] Cf. supr. I. 66. 74.

instrumentorum motum, pertinere. Res enim (exempli gratia) subtilis est certe et accurata confectio horologiorum, talis scilicet, quæ cœlestia in rotis, pulsum animalium in motu successivo et ordinato, videatur imitari; quæ tamen res ex uno aut altero naturæ axiomate pendet [82].

Quod si quis rursus subtilitatem illam intueatur, quæ ad artes liberales pertinet [83]; aut etiam eam, quæ ad corporum naturalium præparationem per artes mechanicas spectat, et hujusmodi res suspiciat; veluti inventionem motuum cœlestium in astronomia, concentuum in musica, literarum alphabeti (quæ etiam adhuc in regno Sinarum in usu non sunt) in grammatica; aut rursus in mechanicis, factorum Bacchi et Cereris, hoc est, præparationum [84] vini et cervisiæ, panificiorum, aut etiam mensæ deliciarum, et distillationum, et similium: ille quoque, si secum cogitet, et animum advertat, per quantos temporum circuitus (cum hæc omnia, præter distillationes, antiqua fuerint) hæc ad eam, quam nunc habemus, culturam perducta sint, et (ut jam de horologiis dictum est) quam parum habeant ex observationibus et axiomatibus naturæ, atque quam facile, et tanquam per occasiones obvias, et contemplationes incurrentes, ista inveniri potuerint: ille (inquam) ab omni admiratione se facile liberabit, et potius humanæ con-

[82] Cf. supr. I. 25. Our object in prosecuting physical discoveries should be twofold; (1) the discovery of hitherto unknown *powers* or forces, such as Galvanism, Electricity, Actinism of solar rays; (2) the application of such powers as we are aware of to the requirements of science and of life, as we may see if we consider (e. g.) the origin and application of Steam.

[83] Bacon's "liberal arts" are very defective; and it is singular how little a man with his grand imagination seems to have been impressed by the fine Arts. Cf. supr. I. 7.

[84] *præparationem* is the reading hitherto followed. But in the errata of edit. 1620 Bacon has corrected it to *præparationum*, which is clearly better.

ditionis miserebitur, quod per tot secula tanta fuerit rerum et inventorum penuria et sterilitas. Atque hæc ipsa tamen, quorum nunc mentionem fecimus, inventa, philosophia et artibus intellectus antiquiora fuerunt: adeo ut (si verum dicendum sit) cum hujusmodi scientiæ rationales et dogmaticæ inceperint, inventio operum utilium desierit.

Quod si quis ab officinis ad bibliothecas se converterit, et immensam, quam videmus, librorum varietatem in admiratione habuerit, is, examinatis et diligentius introspectis ipsorum librorum materiis et contentis, obstupescet certe in contrarium; et postquam nullum dari finem repetitionibus observaverit, quamque homines eadem agant et loquantur, ab admiratione varietatis transibit ad miraculum indigentiæ et paucitatis earum rerum, quæ hominum mentes adhuc tenuerunt et occuparunt.

Quod si quis ad intuendum ea, quæ magis curiosa habentur quam sana, animum submiserit, et alchemistarum aut magorum[85] opera penitius[86] introspexerit, is dubitabit forsitan, utrum risu, an lachrymis potius illa digna sint. Alchemista enim spem alit æternam, atque ubi res non succedit, errores proprios reos substituit; secum accusatorie reputando, se aut artis aut auctorum vocabula non satis intellexisse; unde ad traditiones et auriculares susurros animum applicat; aut in practicæ suæ scrupulis et momentis aliquid titubatum esse; unde experimenta in infinitum repetit:

[85] Cf. Adv. of Learning, p. 44; supr. I. 5: and for a more friendly view see infr. II. 31. Bacon was inclined "in a purified sense" to take *magia* as handmaid to the discovery of Forms. Cf. infr. II. 9.

[86] "Penitius" is a form scarcely allowed; and when it does occur it is in very late writers, and with the option of other readings. Still as Bacon doubtless wrote *penitius* and not *penitus* in this place, I have not hesitated to retain it.

ac interim quum inter experimentorum sortes, in quædam incidit aut ipsa facie nova, aut utilitate non contemnenda; hujusmodi pignoribus animum pascit, eaque in majus ostentat et celebrat: reliqua spe sustentat. Neque tamen negandum est[87], alchemistas non pauca invenisse, et inventis utilibus homines donasse. Verum fabula illa non male in illos quadrat de sene, qui filiis aurum in vinea defossum (sed locum se nescire simulans) legaverit, unde illi vineæ fodiendæ diligenter incubuerunt, et aurum quidem nullum repertum, sed vindemia ex ea cultura facta est uberior.

At naturalis magiæ cultores, qui per rerum sympathias[88] omnia expediunt, ex conjecturis otiosis et supinissimis rebus virtutes et operationes admirabiles affinxerunt; atque si quando opera exhibuerint, ea illius sunt generis, ut ad admirationem et novitatem, non ad fructum et utilitatem, accommodata sint.

In superstitiosa autem magia (si et de hac dicendum sit) illud inprimis animadvertendum est, esse tantummodo certi cujusdam et definiti generis subjecta, in quibus artes curiosæ et superstitiosæ, per omnes nationes, atque ætates, atque etiam religiones, aliquid potuerint aut luserint. Itaque ista missa faciamus. Interim nil mirum est, si opinio copiæ causam inopiæ dederit.

LXXXVI.

Atque hominum admirationi, quoad doctrinas et artes, per se satis simplici et prope puerili, incrementum accessit ab eorum astu et artificio, qui scientias tractaverunt et tradiderunt. Illi enim ea ambitione et affectatione eas proponunt, atque in eum modum efformatas,

87 Cf. supr. I. 73.

88 *sympathiæ*: cf. infr. II. 50. 6, where Bacon's own view of the "consent of Nature" is given at length.

ac veluti personatas, in hominum conspectum producunt, ac si illæ omni ex parte perfectæ essent, et ad exitum perductæ. Si enim methodum aspicias et partitiones[89], illæ prorsus omnia complecti et concludere videntur, quæ in illud subjectum cadere possunt. Atque licet membra illa male impleta, et veluti capsulæ inanes sint; tamen apud intellectum vulgarem scientiæ formam et rationem integræ præ se ferunt.

At primi et antiquissimi veritatis inquisitores, meliore fide et fato, cognitionem illam, quam ex rerum contemplatione decerpere, et in usum recondere statuebant, in *aphorismos*, sive breves, easdemque sparsas, nec methodo revinctas sententias, conjicere solebant; neque se artem universam complecti simulabant, aut profitebantur. At eo quo nunc res agitur modo, minime mirum est, si homines in iis ulteriora non quærant, quæ pro perfectis et numeris suis jampridem absolutis traduntur.

LXXXVII.

Etiam antiqua magnum existimationis et fidei incrementum acceperunt ex eorum vanitate et levitate, qui nova proposuerunt; præsertim in philosophiæ naturalis parte activa et operativa. Neque enim defuerunt homines vaniloqui et phantastici, qui partim ex credulitate, partim ex impostura, genus humanum promissis onerarunt: vitæ prolongationem, senectutis retardationem, dolorum levationem, naturalium defectuum reparationem, sensuum deceptiones, affectuum ligationes et incitationes[90], intellectualium facultatum illuminatio-

[89] This would hold especially of the older deductive system; but also of the universal eagerness after a perfect outline, which leads men to sketch out what they cannot fill up.

[90] This language reminds one of Electrobiology and other delusions of modern days. The interested generalizations of quacks have done much to damage the repute of more than one branch of Physical Science.

nes et exaltationes, substantiarum transmutationes, et motuum ad libitum roborationes et multiplicationes, aeris impressiones et alterationes, cœlestium influentiarum deductiones et procurationes, rerum futurarum divinationes, remotarum repræsentationes, occultarum revelationes, et alia complura pollicitando et ostentando. Verum de istis largitoribus non multum aberraverit, qui istiusmodi judicium fecerit, tantum nimirum in doctrinis philosophiæ, inter horum vanitates, et veras artes, interesse, quantum inter res gestas Julii Cæsaris, aut Alexandri Magni, et res gestas Amadicii ex Gallia[91], aut Arturi ex Britannia, in historiæ narrationibus intersit. Inveniuntur enim clarissimi illi imperatores revera majora gessisse, quam umbratiles isti heroes etiam fecisse fingantur; sed modis et viis scilicet actionum minime fabulosis et prodigiosis. Neque propterea æquum est, veræ memoriæ fidem derogari, quod a fabulis illa quandoque læsa sit et violata. Sed interim minime mirum est, si propositionibus novis (præsertim cum mentione operum) magnum sit factum præjudicium per istos impostores, qui similia tentaverunt; cum vanitatis excessus et fastidium etiam nunc omnem in ejusmodi conatibus magnanimitatem destruxerit.

LXXXVIII.

At longe majora a pusillanimitate, et pensorum, quæ humana industria sibi proposuit, parvitate et tenuitate, detrimenta in scientias invecta sunt. Et tamen (quod pessimum est) pusillanimitas ista non sine arrogantia et fastidio se offert.

Primum enim, omnium artium illa reperitur cautela

Bacon is here referring to the language of the Alchemists of his day.

91 "Amadis de Gaul;" a famous mediæval romance. The first edition of it that is extant was printed at Seville A.D. 1519. See Hallam's Lit. of Europe, part I. chap. iv. § 70.

jam facta familiaris, ut in qualibet arte auctores artis suæ infirmitatem in naturæ calumniam vertant; et quod ars ipsorum non assequitur, id ex eadem arte impossibile in natura pronunciant. Neque certe damnari potest ars, si ipsa judicet. Etiam philosophia, quæ nunc in manibus est, in sinu suo posita quædam fovet, aut placita, quibus (si diligentius inquiratur) hoc hominibus omnino persuaderi volunt; nil ab arte, vel hominis opere, arduum, aut in naturam imperiosum et validum, expectari debere; ut de heterogenia caloris astri et ignis, et mistione, superius[92] dictum est. Quæ si notentur accuratius, omnino pertinent ad humanæ potestatis circumscriptionem malitiosam, et ad quæsitam et artificiosam desperationem, quæ non solum spei auguria turbet, sed etiam omnes industriæ stimulos et nervos incidat, atque ipsius experientiæ aleas abjiciat; dum de hoc tantum solliciti sint, ut ars eorum perfecta censeatur; gloriæ vanissimæ et perditissimæ dantes operam, scilicet ut quicquid adhuc inventum et comprehensum non sit, id omnino nec inveniri, nec comprehendi posse in futurum credatur. At si quis rebus addere se, et novum aliquid reperire conetur, ille tamen omnino sibi proponet et destinabit unum aliquod inventum (nec ultra) perscrutari et eruere; ut magnetis naturam, maris fluxum et refluxum, thema cœli, et hujusmodi, quæ secreti aliquid habere videntur, et hactenus parum feliciter tractata sint: quum summæ sit imperitiæ, rei alicujus naturam in se ipsa perscrutari[93]: quandoquidem eadem natura, quæ in aliis vide-

[92] Cf. supr. I. 75.

[93] The narrowness of mind which leads men to investigate one subject by itself is not peculiar to physics; it is found in History, Politics, Morals—universally. It is the parent of all one-sided views; of all partizanship. It often gives vigour and point; just as some strange views gain plenty of proselytes, by being earnestly and zealously supported, without consideration of any colla-

tur latens et occulta, in aliis manifesta sit, et quasi palpabilis; atque in illis admirationem, in his ne attentionem quidem moveat. Ut fit in natura consistentiæ[94], quæ in ligno vel lapide non notatur, sed solidi appellatione transmittitur, neque amplius de fuga separationis aut solutionis continuitatis inquiritur: at in aquarum bullis eadem res videtur subtilis et ingeniosa; quæ bullæ se conjiciunt in pelliculas quasdam, in hemisphærii formam curiose effictas, ut ad momentum temporis evitetur solutio continuitatis.

Atque prorsus illa ipsa, quæ habentur pro secretis, in aliis habent naturam manifestam et communem; quæ nunquam se dabit conspiciendam, si hominum experimenta aut contemplationes in illis ipsis tantum versentur. Generaliter autem et vulgo, in operibus mechanicis habentur pro novis inventis, si quis jampridem inventa subtilius poliat, vel ornet elegantius, vel simul uniat et componat, vel cum usu commodius copulet, aut opus majore, aut etiam minore, quam fieri consuevit, mole vel volumine exhibeat, et similia.

Itaque minime mirum est, si nobilia, et genere humano digna inventa in lucem extracta non sint, quum homines hujusmodi exiguis pensis et puerilibus contenti et delectati fuerint; quinetiam in iisdem se magnum aliquod sequutos, aut assequutos putaverint.

LXXXIX.

Neque illud prætermittendum est, quod nacta sit

teral circumstances. This is the reason of the success of some wild sects. Carried too far, and connected with the Imagination, this one-sidedness becomes madness. But Truth is obtained by diligent collation of what seem antagonistic facts; by acknowledging all limiting truths; by searching out the history of the same power as it acts under different circumstances &c.

[94] So gravity is noticeable in a falling apple, but passes unheeded in a revolving world. "Consistentia" is the mutual attraction of particles.

philosophia naturalis per omnes ætates adversarium molestum et difficilem; superstitionem nimirum, et zelum religionis cæcum et immoderatum[95]. Etenim videre est apud Græcos[96], eos, qui primum causas naturales fulminis et tempestatum insuetis adhuc hominum auribus proposuerunt, impietatis in deos eo nomine damnatos: nec multo melius a nonnullis antiquorum patrum religionis Christianæ exceptos fuisse eos, qui ex certissimis demonstrationibus (quibus nemo hodie sanus contradixerit) terram rotundam esse posuerunt, atque ex consequenti antipodas esse asseruerunt.

Quinetiam, ut nunc sunt res, conditio sermonum de natura facta est durior et magis cum periculo, propter theologorum scholasticorum summas et methodos; qui cum theologiam (satis pro potestate) in ordinem redegerint, et in artis formam effinxerint, hoc insuper effecerunt, ut pugnax et spinosa Aristotelis philosophia corpori religionis, plus quam per erat, immisceretur.

Eodem etiam spectant (licet diverso modo) eorum commentationes, qui veritatem Christianæ religionis ex principiis ex auctoritatibus philosophorum deducere et confirmare haud veriti sunt; fidei et sensus conjugium tanquam legitimum multa pompa et solennitate celebrantes, et grata rerum varietate animos hominum permulcentes; sed interim divina humanis, impari

[95] Cf. supr. I. 65. and Appendix C. for all this Aphorism.

[96] Cf. Aristoph. Nub. 365. For the belief as to gravity acting upwards, and as to antipodes see Mill, Bk. II. chap. v. § 6.

This Aphorism is a valuable one, as shewing that Bacon was a believer in religion, and a sensible one too. Le Maistre attacks him here very violently: " Parmi le nombre presque infini de Blasphèmes que notre siècle a proférés contre le bon sens, la morale, et la dignité de l'homme, on n'en trouvera pas un seul qui ne se trouve ou virtuellement ou expressément dans les œuvres de Bacon. (Note to Strictures, p. 306.) This is the " animus" of all Le Maistre's attacks, and takes not a little from their value. Hallam's Lit. of Europe, part III. chap. iii. § 51 (note), puts Le Maistre at his right worth very fairly.

conditione, permiscentes. At in hujusmodi misturis theologiæ cum philosophia, ea tantum, quæ nunc in philosophia recepta sunt, comprehenduntur; sed nova, licet in melius mutata, tantum non summoventur et exterminantur.

Denique invenias, ex quorundam theologorum imperitia, aditum alicui philosophiæ, quamvis emendatæ, pene interclusum esse. Alii siquidem simplicius subverentur, ne forte altior in naturam inquisitio ultra concessum sobrietatis terminum penetret; traducentes et perperam torquentes ea, quæ de divinis mysteriis in Scripturis sacris adversus rimantes secreta divina dicuntur, ad occulta naturæ, quæ nullo interdicto prohibentur[97]. Alii callidius conjiciunt et animo versant, si media ignorentur, singula ad manum et virgulam divinam (quod religionis, ut putant, maxime intersit) facilius posse referri: quod nihil aliud est, quam *Deo per mendacium gratificari*[98] velle. Alii ab exemplo metuunt, ne motus et mutationes circa philosophiam in religionem incurrant, ac desinant. Alii denique solliciti videntur, ne in naturæ inquisitione aliquid inveniri possit, quod religionem (præsertim apud indoctos) subvertat, aut saltem labefactet. At isti duo posteriores metus nobis videntur omnino sapientiam animalem sapere[99]; ac si homines in mentis suæ recessibus, et secretis cogitationibus, de firmitudine religio-

[97] Like those who in our day have been suffering from a foolish fear lest Geology should subvert the Faith. "Rimantes secreta divina" is perhaps an allusion to Coloss. ii. 18. "Intruding with those things which he hath not seen."

[98] This, without being an exact quotation, is taken from Job xiii. 7. "Will ye speak wickedly for God? and talk deceitfully for him?" Bacon makes a similar quotation in the Advancement of Learning (p. 13). "It is good to ask the question which Job asked of his friends: Will you lie for God, as one man will do for another to gratify him?"

[99] Cf. Adv. of Learning, p. 63.

nis, et fidei in sensum imperio, diffiderent ac dubitarent; et propterea ab inquisitione veritatis in naturalibus periculum illis impendere metuerent. At vere rem reputanti, philosophia naturalis, post verbum Dei, certissima superstitionis medicina est[100]; eademque probatissimum fidei alimentum. Itaque merito religioni donatur tanquam fidissima ancilla: cum altera voluntatem Dei, altera potestatem manifestet. Neque enim erravit Ille, qui dixit; *erratis, nescientes Scripturas, et potestatem Dei*[1]*:* informationem de voluntate, et meditationem de potestate, nexu individuo commiscens et copulans. Interim minus mirum est, si naturalis philosophiæ incrementa cohibita sint; cum religio, quæ plurimum apud animos hominum pollet, per quorundam imperitiam et zelum incautum in partem contrariam transierit, et abrepta fuerit.

XC.

Rursus in moribus et institutis scholarum, academiarum, collegiorum, et similium conventuum, quæ doctorum hominum sedibus, et eruditionis culturæ destinata sunt, omnia progressui scientiarum adversa inveniuntur. Lectiones enim et exercitia ita sunt disposita, ut aliud a consuetis haud facile cuiquam in mentem veniat cogitare, aut contemplari[2]. Si vero

[100] So also in the Filum Labyrinthi, § 7. It is worth considering this judicious distinction between the functions of Holy Writ, and those of Nature. One is reminded of Butler's famous structure built upon the analogy between the material world and the spiritual. The two have each their part; and they must correspond. And it is a strange tyranny which men are wont to exercise in God's name over the minds of their brethren, as though they thought that the world was a device of the evil one, instead of the work of God. Cf. Browne's Rel. Med. I. 16. Keble's Christian Year, Septuag. Sunday.

[1] Matth. xxii. 29.

[2] Bacon might have had in mind the University of Paris, and the Ramist Logic, as well as the general system of Scholastic disputations, whose shadow still lingers among us.

unus aut alter fortasse judicii libertate uti sustinuerit, is sibi soli hanc operam imponere possit; ab aliorum autem consortio nihil capiet utilitatis. Sin et hoc toleraverit, tamen in capessenda fortuna industriam hanc et magnanimitatem sibi non levi impedimento fore experietur. Studia enim hominum in ejusmodi locis in quorundam auctorum scripta, veluti in carceres, conclusa sunt; a quibus si quis dissentiat, continuo ut homo turbidus, et rerum novarum cupidus corripitur[3]. At magnum certe discrimen inter res civiles, et artes: non enim idem periculum a novo motu, et a nova luce. Verum in rebus civilibus mutatio etiam in melius suspecta est ob perturbationem; cum civilia auctoritate, consensu, fama, et opinione, non demonstratione, nitantur. In artibus autem et scientiis, tanquam in metalli fodinis, omnia novis operibus et ulterioribus progressibus circumstrepere debent. Atque

[3] It is to be regretted that such a work as Aldrich's "Rudiments" should still be the only text-book on Logic acknowledged in one University. "I cannot," says D. Stewart, (Phil. of the Human Mind, at the conclusion of the work,) "dismiss the subject, without remarking, as a fact which at some future period will figure in Literary History, that two hundred years after the date of Bacon's philosophical works, the antiquated routine of study originally prescribed in times of scholastic barbarism and of Popish superstition, should, in so many universities, be suffered still to stand in the way of improvements recommended at once by the present state of the Sciences, and by the order which Nature follows in developing the intellectual faculties." Although this censure is now partly obsolete, it cannot be denied that the work mentioned above hinders the satisfactory study of a most useful branch of mental Philosophy, gives a false impression of it, and disgusts men with that which it professes to teach. Men learn from it a few barren "laws of thought," without being taught to reflect on what *thought* is, and what is the constitution of the Mind.

"Ut homo turbidus." Such was the outcry against Galileo, against Locke, and, to a certain extent, against this very work of Bacon's. It was thought to have a great tendency to produce "dangerous revolutions," and to "subvert" governments and overturn Religion. Among others, one Dr. Stubbe denounced the whole race of Experimentalists with the happy nickname of "the Bacon-faced generation." Account of the Nov. Org., Lib. of Useful Knowledge, ii. p. 37.

secundum rectam rationem res ita se habet, sed interim non ita vivitur: sed ista, quam diximus, doctrinarum administratio et politia scientiarum augmenta durius premere consuevit.

XCI.

Atque insuper licet ista invidia cessaverit; tamen satis est ad cohibendum augmentum scientiarum, quod hujusmodi conatus et industriæ præmiis careant. Non enim penes eosdem est cultura scientiarum, et præmium. Scientiarum enim augmenta a magnis utique ingeniis proveniunt; at pretia et præmia scientiarum sunt penes vulgus aut principes viros, qui (nisi raro admodum) vix mediocriter docti sunt. Quinetiam hujusmodi progressus, non solum præmiis et beneficentia hominum, verum etiam ipsa populari laude destituti sunt. Sunt enim illi supra captum maximæ partis hominum, et ab opinionum vulgarium ventis facile obruuntur et extinguuntur. Itaque nil mirum, si res illa non feliciter successerit, quæ in honore non fuit.

XCII.

Sed longe maximum progressibus scientiarum, et novis pensis ac provinciis in iisdem suscipiendis, obstaculum deprehenditur in desperatione hominum, et suppositione impossibilis[4]. Solent enim viri prudentes et severi in hujusmodi rebus plane diffidere: naturæ obscuritatem, vitæ brevitatem, sensuum fallacias, judicii infirmitatem, experimentorum difficultates, et similia secum reputantes. Itaque existimant, esse quosdam scientiarum, per temporum et ætatum mundi revolu-

[4] This difficulty from man's despair is no new thing. Cf. Dr. Jeremie's Essay on the Sceptics in the Encycl. Metrop. It leads Bacon to consider its contrary—Hope, and its grounds.

tiones, fluxus et refluxus[5]; cum aliis temporibus crescant et floreant, aliis declinent et jaceant: ita tamen, ut cum ad certum quendam gradum et statum pervenerint, nil ulterius possint.

Itaque si quis majora credat aut spondeat, id putant esse cujusdam impotentis et immaturi animi; atque hujusmodi conatus initia scilicet læta, media ardua, extrema confusa habere. Atque cum hujusmodi cogitationes eæ sint, quæ in viros graves et judicio præstantes facile cadant; curandum revera est, ne rei optimæ et pulcherrimæ amore capti severitatem judicii relaxemus, aut minuamus; et sedulo videndum, quid spei affulgeat, et ex qua parte se ostendat; atque auris levioribus spei rejectis, eæ, quæ plus firmitudinis habere videntur, omnino discutiendæ sunt et pensitandæ. Quinetiam prudentia civilis ad consilium vocanda est et adhibenda, quæ ex præscripto diffidit, et de rebus humanis in deterius conjicit[6]. Itaque jam et de spe dicendum est; præsertim cum nos promissores non simus, nec vim aut insidias hominum judiciis faciamus aut struamus, sed homines manu et sponte ducamus. Atque licet longe potentissimum futurum sit remedium ad spem imprimendam, quando homines ad particularia, præsertim in tabulis nostris inveniendi digesta et

[5] In all social affairs there is but little absolute progress; for each gain is but a narrow balance won by the good from the evil. But in Physical Sciences this now scarcely holds good, since the "Literata experientia" has made the knowledge of each age remain to assist the next. So too in modern Mathematics: they have never had "fluxus et refluxus:" their's is a steady progress of improvement. But all moral subjects seem to be under this law; as are their kin, Political questions.

[6] This is like the principle which Butler makes use of for action in contingencies. So Aristotle's Rhet. II. 13, sketches the character of old men: διὰ γὰρ τὸ πολλὰ ἔτη βεβιωκέναι καὶ πλείω ἐξαπατῆσθαι καὶ ἡμαρτηκέναι, καὶ τὰ πλείω φαῦλα εἶναι τῶν πραγμάτων, οὐ διαβεβαιοῦνται οὐδέν· and again, καὶ δυσέλπιδες διὰ τὴν ἐμπειρίαν· τὰ γὰρ πλείω τῶν γιγνομένων φαῦλά ἐστιν.

disposita, (quæ partim ad secundam, sed multo magis ad quartam *Instaurationis*[7] nostræ partem pertinent) adducemus; cum hoc ipsum sit non spes tantum, sed tanquam res ipsa: tamen ut omnia clementius fiant, pergendum est in instituto nostro de præparandis hominum mentibus; cujus præparationis ista ostensio spei pars est non exigua. Nam absque ea, reliqua faciunt magis ad contristationem hominum, (scilicet, ut deteriorem et viliorem habeant de iis, quæ jam in usu sunt, opinionem, quam nunc habent; et suæ conditionis infortunium plus sentiant et pernoscant) quam ad alacritatem aliquam inducendam, aut industriam experiendi acuendam. Itaque conjecturæ nostræ, quæ spem in hac re faciunt probabilem, aperiendæ sunt et proponendæ: sicut Columbus fecit, ante navigationem illam suam mirabilem maris Atlantici: cum rationes adduxerit, cur ipse novas terras et continentes præter eas, quæ ante cognitæ fuerunt, inveniri posse confideret: quæ rationes licet primo rejectæ, postea tamen experimento probatæ sunt, et rerum maximarum causæ et initia fuerunt.

XCIII.

Principium autem sumendum a Deo[8]: hoc nimirum quod agitur, propter excellentem in ipso boni naturam, manifeste a Deo esse; qui auctor boni, et pater luminum est. In operationibus autem divinis, initia quæque tenuissima exitum certo trahunt. Atque quod de

[7] The fourth Part of the Instauration is, as Bacon states in the Distributio, the particular application of the Second (i. e. of the Nov. Org.). It has for its object the Collection of Examples of Inquiry and Investigation—such as that of Heat, given in the 2nd Book of the Nov. Org.

[8] A farther refutation of Le Maistre's attack on Bacon as an Atheist: as he also says in the Pref. to the Instauration; "Nos certe æterno veritatis amore devicti, viarum incertis et arduis et solitudinibus nos commisimus; et *Divino auxilio freti et innixi*, mentem nostram—sustinuimus."

spiritualibus dictum est, *Regnum Dei non venit cum observatione*[9]*;* id etiam in omni majore opere Providentiæ evenire reperitur: ut omnia sine strepitu et sonitu placide labantur; atque res plane agatur, priusquam homines eam agi putent aut advertant. Neque omittenda est prophetia Danielis de ultimis mundi temporibus; *Multi pertransibunt, et multiplex erit scientia*[10]*:* manifeste innuens et significans, esse in fatis, id est, in Providentia, ut pertransitus mundi (qui per tot longinquas navigationes impletus plane, aut jam in opere esse videtur) et augmenta scientiarum in eandem ætatem incidant.

XCIV.[11]

Sequitur ratio omnium maxima ad faciendam spem; nempe ex erroribus temporis præteriti, et viarum adhuc tentatarum. Optima enim est ea reprehensio, quam de statu civili haud prudenter administrato quispiam his verbis complexus est[12]: *Quod ad præterita pessimum est, id ad futura optimum videri debet. Si enim vos omnia, quæ ad officium vestrum spectant, præstitissetis, neque tamen res vestræ in meliore loco essent; ne spes quidem ulla reliqua foret, eas in melius provehi posse. Sed cum rerum vestrarum status, non a vi ipsa rerum, sed ab erroribus vestris male se habeat; sperandum est, illis erroribus missis aut correctis, magnam rerum in melius mutationem fieri posse.* Simili modo,

9 Luke xvii. 20.

10 Daniel xii. 4. This text has been often applied to the peculiarities of modern civilization.

11 These Aphorisms 94—108 pass over a good deal of old ground: a fault not uncommon in Bacon, who is very apt to repeat himself. The Aphorisms on the *Idola* gave us many of these errors.

12 Demosth. Phil. iii. τὸ χείριστον ἐν τοῖς παρεληλυθόσι, τοῦτο πρὸς τὰ μέλλοντα βέλτιστον ὑπάρχει. Τί οὖν ἐστὶ τοῦτο; ὅτι οὔτε μικρὸν, οὔτε μέγα οὐδὲν τῶν δεόντων ποιούντων ὑμῶν, κακῶς τὰ πράγματα ἔχει· ἐπεί τοι εἰ πάνθ' ἃ προσήκει πραττόντων ὑμῶν οὕτω διέκειτο, οὐδ' ἂν ἐλπὶς ἦν αὐτὰ γενέσθαι βελτίω, νῦν δὲ τῆς μὲν ῥᾳθυμίας τῆς ὑμετέρας καὶ τῆς ἀμελείας κεκράτηκε Φίλιππος, τῆς πόλεως δ' οὐ κεκράτηκεν.

si homines per tanta annorum spatia viam veram inveniendi et colendi scientias tenuissent, nec tamen ulterius progredi potuissent; audax proculdubio et temeraria foret opinio, posse rem in ulterius provehi. Quod si in via ipsa erratum sit, atque hominum opera in iis consumpta, in quibus minime oportebat; sequitur ex eo, non in rebus ipsis difficultatem oriri, quæ potestatis nostræ non sunt; sed in intellectu humano, ejusque usu et applicatione; quæ res remedium et medicinam suscipit. Itaque optimum fuerit illos ipsos errores proponere: quot enim fuerint errorum impedimenta in præterito, tot sunt spei argumenta in futurum. Ea vero licet in his, quæ superius dicta sunt, non intacta omnino fuerint; tamen ea etiam nunc breviter, verbis nudis ac simplicibus, repræsentare visum est.

XCV.

Qui tractaverunt scientias, aut empirici[13], aut dogmatici[14] fuerunt. Empirici, formicæ more, congerunt tantum, et utuntur: rationales, aranearum more, telas ex se conficiunt: apis vero ratio media est, quæ materiam ex floribus horti et agri elicit; sed tamen eam propria facultate vertit et digerit. Neque absimile philosophiæ verum opificium est; quod nec mentis viribus tantum aut præcipue nititur, neque ex historia naturali et mechanicis experimentis præbitam materiam in memoria integram, sed in intellectu mutatam et subactam, reponit. Itaque ex harum facultatum (experimentalis scilicet, et rationalis) arctiore et sanctiore fœdere (quod adhuc factum non est) bene sperandum est.

XCVI.

Naturalis philosophia adhuc sincera non invenitur,

[13] Cf. supr. I. 64. [14] Cf. Preface and supr. I. 6-.

sed infecta et corrupta[15]: in Aristotelis schola, per logicam; in Platonis schola, per theologiam naturalem; in secunda schola Platonis, Procli, et aliorum, per mathematicam; quæ philosophiam naturalem terminare, non generare aut procreare debet[16]. At ex philosophia naturali pura et impermista, meliora speranda sunt.

XCVII.

Nemo adhuc tanta mentis constantia et rigore inventus est, ut decreverit et sibi imposuerit theorias et notiones communes penitus abolere, et intellectum abrasum et æquum ad particularia de integro applicare[17]. Itaque ratio illa humana, quam habemus, ex multa fide, et multo etiam casu, nec non ex puerilibus, quas primo hausimus, notionibus, farrago quædam est et congeries.

Quod si quis ætate matura, et sensibus integris, et mente repurgata, se ad experientiam et ad particularia de integro applicet, de eo melius sperandum est. Atque hac in parte nobis spondemus fortunam Alexandri Magni: neque quis nos vanitatis arguat, antequam exitum rei audiat, quæ ad exuendam omnem vanitatem spectat.

Etenim de Alexandro et ejus rebus gestis Æschines[18]

[15] Cf. supr. I. 54. 63; Adv. of Learning, p. 51. For Plato's intermixture of Theology see the Timæus.

[16] This, on the functions of Mathematics as merely giving the limits of Natural Science, is far too narrow. Bacon had, of course, no knowledge of the intimate connection between high and abstract Mathematics and Physical truths, as we see them meeting in Astronomy or Optics. For his views on Mathematics see De Augm. Scient. iii. 6; and cf. what Macaulay, Essay on Bacon, says on the point. Cf. infra II. 8.

[17] Quoted by D. Stewart, Phil. of the Human Mind, Introd. II. § 1; where he adds, "a great part of the life of a Philosopher must be devoted not so much to the acquisition of new knowledge, as to unlearn the errors to which he had been taught to give an implicit assent before the dawn of reason and reflection."

[18] Cf. Advancement of Learning,

ita loquutus est: *Nos certe vitam mortalem non vivimus; sed in hoc nati sumus, ut posteritas de nobis portenta narret et prædicet:* perinde ac si Alexandri res gestas pro miraculo habuisset.

At ævis sequentibus Titus Livius melius rem advertit et introspexit, atque de Alexandro hujusmodi quippiam dixit[19]: *Eum non aliud quam bene ausum vana contemnere.* Atque simile etiam de nobis judicium futuris temporibus factum iri existimamus: *Nos nil magni fecisse; sed tantum ea, quæ pro magnis habentur, minoris fecisse.* Sed interim (quod jam diximus) non est spes nisi in *regeneratione* scientiarum; ut eæ scilicet ab experientia certo ordine excitentur et rursus condantur; quod adhuc factum esse aut cogitatum, nemo (ut arbitramur) affirmaverit.

XCVIII.

Atque experientiæ fundamenta (quando ad hanc omnino deveniendum est) aut nulla, aut admodum infirma adhuc fuerunt; nec particularium sylva et materies, vel numero, vel genere, vel certitudine, informando intellectui competens, aut ullo modo sufficiens, adhuc quæsita est et congesta. Sed contra homines docti (supini sane et faciles) rumores quosdam experientiæ, et quasi famas et auras ejus, ad philosophiam suam vel constituendam vel confirmandam exceperunt, atque illis nihilominus pondus legitimi testimonii attribuerunt. Ac veluti si regnum aliquod aut status non ex literis et relationibus a legatis et nuntiis fide dignis

p. 48. *Τοιγάρτοι τί τῶν ἀνελπίστων καὶ ἀπροσδοκήτων ἐφ' ἡμῶν οὐ γέγονεν: Οὐ γὰρ βίον γ' ἡμεῖς ἀνθρώπινον βεβιώκαμεν, ἀλλ' εἰς παραδοξολογίαν τοῖς ἐσομένοις μεθ' ἡμᾶς ἔφυμεν.* Æsch. in Ctes. (§ 115) Æschines is speaking of the prostration of strength of both Lacedæmon and Athens, and of the destruction of Thebes by Alexander, B. C. 335.

[19] Livy IX. 17. in the digression on the probable consequences of a struggle between Rome and Alexander. Cf. I. 110.

missis, sed ex urbanorum sermunculis et ex triviis consilia sua et negotia gubernaret; omnino talis in philosophiam administratio, quatenus ad experientiam, introducta est. Nil debitis modis exquisitum, nil verificatum, nil numeratum, nil appensum, nil dimensum in naturali historia reperitur. At quod in observatione indefinitum et vagum, id in informatione fallax et infidum est. Quod si cui hæc mira dictu videantur, et querelæ minus justæ propiora; cum Aristoteles tantus ipse vir, et tanti regis opibus subnixus, tam accuratam *de animalibus* historiam confecerit; atque alii nonnulli majore diligentia (licet strepitu minore) multa adjecerint; et rursus alii de plantis, de metallis, et fossilibus, historias et narrationes copiosas conscripserint; is sane non satis attendere et perspicere videtur, quid agatur in præsentia. Alia enim est ratio naturalis historiæ, quæ propter se confecta est; alia ejus, quæ collecta est ad informandum intellectum in ordine ad condendam philosophiam[20]. Atque hæ duæ historiæ tum aliis rebus, tum præcipue in hoc differunt; quod prima ex illis specierum naturalium varietatem, non artium mechanicarum experimenta contineat. Quemadmodum enim in civilibus ingenium cujusque, et occultus animi affectuumque sensus, melius elicitur, cum quis in perturbatione ponitur, quam alias: simili modo, et occulta naturæ magis se produnt per vexationes artium, quam cum cursu suo meant. Itaque tum demum bene sperandum est de naturali philosophia, postquam historia naturalis (quæ ejus basis est et fundamentum) melius instructa fuerit; antea vero minime.

[20] This is an unfair assumption. Aristotle's Physical works were most valuable in themselves, and intended as means "ad condendam philosophiam."

XCIX.

Atque rursus in ipsa experimentorum mechanicorum copia, summa eorum, quæ ad intellectus informationem maxime faciunt et juvant, detegitur inopia. Mechanicus enim, de veritatis inquisitione nullo modo sollicitus, non ad alia, quam quæ operi suo subserviunt, aut animum erigit, aut manum porrigit. Tum vero de scientiarum ulteriore progressu spes bene fundabitur, quum in historiam naturalem recipientur et aggregabuntur complura experimenta, quæ in se nullius sunt usus, sed ad inventionem causarum et axiomatum tantum faciunt[21]; quæ nos *lucifera* experimenta ad differentiam *fructiferorum* appellare consuevimus. Illa autem miram habent in se virtutem et conditionem; hanc videlicet, quod nunquam fallant, aut frustrentur. Cum enim ad hoc adhibeantur, non ut opus aliquod efficiant, sed ut causam naturalem in aliquo revelent, quaqua versum cadunt, intentioni æque satisfaciunt, cum quæstionem terminent.

C.

At non solum copia major experimentorum quærenda est et procuranda, atque etiam alterius generis, quam adhuc factum est; sed etiam methodus[22] plane alia, et ordo, et processus, continuandæ et provehendæ experientiæ, introducenda. Vaga enim experientia, et se

[21] This remark is illustrated by the collection of Instances for the discovery of Heat. See II. 11–20.

For "lucifera" and "fructifera" cf. I. 70 and 121. Also De Augm. Scient. V. 2 (ad fin.)

[22] This brings us gradually to Bacon's own Method of Science, which singularly comes in as a part of the "Pars Destruens" of the Book. It is in reality only set forth here in contrast to the older Systems. It corresponds to the old "Logical Method." "Logical Method" descends steadily "per media axiomata"—from step to step, from conclusion to conclusion (assuming however as Hypotheses the most general Axioms); while this, the Inductive Method, ascends *seriatim* from point to point, assuming only the fact of the evidence of the senses being sufficient for man constituted as he is.

tantum sequens, (ut superius dictum est) mera palpatio est, et homines potius stupefacit, quam informat. At cum experientia lege certa procedet, seriatim et continenter, de scientiis aliquid melius sperari poterit.

CI.

Postquam vero copia et materies historiæ naturalis et experientiæ talis, qualis ad opus intellectus, sive ad opus philosophicum requiritur, præsto jam sit et parata; tamen nullo modo sufficit intellectus, ut in illam materiam agat sponte et memoriter; non magis, quam si quis computationem alicujus ephemeridis memoriter se tenere, et superare posse speret. Atque hactenus tamen potiores meditationis partes, quam scriptionis, in inveniendo fuerunt; neque adhuc experientia literata[23] facta est: atqui nulla nisi de scripto inventio probanda est. Illa vero in usum veniente, ab experientia, facta demum literata, melius sperandum.

CII.

Atque insuper, cum tantus sit particularium nume-

[23] "Literate experience." Cf. De Augm. Scient. V. 2. Adv. of Learning, p. 186. One sense given to this phrase is "experience learnedly or scientifically conducted"—not so much an Art or part of Philosophy, as a certain species of Sagacity—"Venatio Panis." This would be the highest sense of the phrase, as indicating experience thoroughly well ordered and arranged. But here it merely signifies experience reduced to writing, when experiments are recorded and duly classified. *Μνήμην δ' ἁπάντων μουσομήτορ' ἐργάνην* Bacon holds to be insufficient. Memory without registry of facts, is what the *recited* Epic would be to the *printed* History. Such registering has of course a tendency to produce *Methodical* experiment; and Memory dies with each man, while "litera scripta manet." The danger of our age is not the want, but the abundance of literate experience. Men actually propose "Congresses" of persons qualified, to gather into Pandects existing knowledge, that so no time may be lost through the great variety of information. Encyclopædias are an evidence of this want. This is however being done quietly by the ordinary progress of things. Chemists have gathered into a compendious shape all the well proved facts of their Science; and *rejections* are constantly going on, as new observations and experiments are brought out.

rus, et quasi exercitus, isque ita sparsus et diffusus, ut intellectum disgreget et confundat; de velitationibus, et levibus motibus, et transcursibus intellectus, non bene sperandum est; nisi fiat instructio et coordinatio per tabulas inveniendi idoneas, et bene dispositas, et tanquam vivas, eorum quæ pertinent ad subjectum, in quo versatur inquisitio, atque ad harum tabularum auxilia præparata et digesta mens applicetur.

CIII[24].

Verum post copiam particularium rite et ordine veluti sub oculos positorum, non statim transeundum est ad inquisitionem, et inventionem novorum particularium, aut operum; aut saltem, si hoc fiat, in eo non acquiescendum. Neque enim negamus, postquam omnia omnium artium experimenta collecta et digesta fuerint, atque ad unius hominis notitiam et judicium pervenerint; quin ex ipsa traductione experimentorum unius artis in alias, multa nova inveniri possint, ad humanam vitam et statum utilia, per istam experientiam, quam vocamus literatam: sed tamen minora de ea speranda sunt; majora vero a nova luce axiomatum ex particularibus illis certa via et regula eductorum, quæ

[24] Bacon here shews how strongly his mind was set on the discovery of *Forms*—for such we take his "nova lux axiomatum" to be. He is not content with mere "Literate experience" in each Art—or even with the mutual light discoveries in different Arts shed on one another, (as Colour and Light, Colour and Music, &c. are connected through the medium of Vibration,) but he must reach these highest Truths, and then use a formal deductive process from them. We need hardly add, that Modern Science does not strictly follow this system, never has reached these *Forms* (if we understand them rightly), nor has consciously descended — except perhaps in the case of Optics — which "terminata in Mathematico," as Bacon would say, have been carried forwards rapidly and deductively. But still the formulæ which are the principles of Optics are scarcely what Bacon would have meant by *Forms*. This Aphorism is carried out more fully in the next. It is too the germ of the "Scala Intellectus" in the Fourth Part of the Instauratio. The subject is treated more fully in Appendix D.

rursus nova particularia indicent et designent. Neque enim in plano via sita est, sed ascendendo, et descendendo; ascendendo primo ad axiomata, descendendo ad opera.

CIV[25].

Neque tamen permittendum est, ut intellectus a particularibus ad axiomata remota et quasi generalissima (qualia sunt principia, quæ vocant, artium, et rerum) saliat et volet; et ad eorum immotam veritatem axiomata media probet, et expediat: quod adhuc factum est, prono ad hoc impetu naturali intellectus, atque etiam ad hoc ipsum per demonstrationes, quæ fiunt per syllogismum, jampridem edocto et assuefacto. Sed de scientiis tum demum bene sperandum est, quando per scalam veram, et per gradus continuos, et non intermissos, aut hiulcos, a particularibus ascendetur ad axiomata minora, et deinde ad media, alia aliis superiora, et postremo demum ad generalissima. Etenim axiomata infima non multum ab experientia nuda discrepant. Suprema vero illa et generalissima (quæ habentur) notionalia[26] sunt, et abstracta, et nil habent solidi. At media sunt axiomata illa vera, et solida, et viva, in quibus humanæ res et fortunæ sitæ sunt; et supra hæc quoque, tandem ipsa illa generalissima; talia scilicet, quæ non abstracta sint, sed per hæc media vere limitantur.

[25] This Aphorism is one of the most important in the whole of Bacon's works; although perhaps "physical Investigation has now far outgrown the Baconian conception of Induction." (Mill's Log. Bk. III. c. iii. § 2.) And did he not seem to foresee this when he wrote at the end of this 1st Book (I. 130) "Artem inveniendi cum inventis adolescere posse, statuere debemus?"

[26] *Notionalia*, "notio" is a favourite Scholastic Term. Here it simply means "residing in the conception of men's minds rather than in things as they are." For a brief account of these "Arbitrary Universals" see D. Stewart's Phil. of the Human Mind, part I. chap. iv. § 6.

Itaque hominum intellectui non plumæ addendæ, sed plumbum potius et pondera; ut cohibeant omnem saltum et volatum. Atque hoc adhuc factum non est; quum vero factum fuerit, melius de scientiis sperare licebit.

CV[27].

In constituendo autem axiomate, forma *inductionis* alia, quam adhuc in usu fuit, excogitanda est; eaque non ad principia tantum (quæ vocant) probanda et invenienda, sed etiam ad axiomata minora, et media, denique omnia. Inductio enim, quæ procedit per enumerationem simplicem[28], res puerilis est, et precario concludit, et periculo exponitur ab instantia contradictoria, et plerumque secundum pauciora quam par est, et ex his tantummodo quæ præsto sunt, pronunciat. At *inductio*, quæ ad inventionem et demonstrationem[29] scientiarum et artium erit utilis, naturam separare debet, per rejectiones et exclusiones debitas; ac deinde post negativas tot quot sufficiunt, super affirmativas concludere; quod adhuc factum non est, nec tentatum certe, nisi tantummodo a Platone, qui ad excutiendas

[27] Cf. Appendices B and D.

[28] This is a part of the Aristotelian Induction, "Inductio cui nihil occurrit in contrarium." See Mill's Logic, Bk. III. chap. xxii. § 4: also Bk. II. chap. iii. § 2. This form of Induction Mill holds to be the basis of our knowledge of what are termed Axioms in Mathematics. For the Baconian Induction, whose characteristics are given below in this Aphorism, (Inductio, quæ ad inventionem et demonstrationem scientiarum, &c.) see Appendix D, and D. Stewart's Phil. of the Human Mind, part II. chap. ix. § 1.

[29] Bacon is perhaps rather to be blamed here for taking a technical word like Demonstratio, and using it as equivalent to that to which it was usually opposed. Demonstratio (ἀπόδειξις) was strictly and perfectly deductive among the previous logical writers. Bacon denies the existence of any such systematic way of reaching truth; and so uses the word in its modern sense as equivalent to "strict proof." Any knowledge fairly proved would now be said to be "demonstrated," and the evidence of the senses would now be called "demonstrative evidence." For Plato's Method of Induction, see Coleridge's Friend, Sect. ii. Essay 8.

definitiones et ideas, hac certe forma inductionis aliquatenus utitur. Verum ad hujus inductionis sive demonstrationis instructionem bonam et legitimam quamplurima adhibenda sunt, quæ adhuc nullius mortalium cogitationem subiere; adeo ut in ea major sit consumenda opera, quam adhuc consumpta est in syllogismo. Atque hujus inductionis auxilio, non solum ad axiomata invenienda, verum etiam ad notiones terminandas, utendum est. Atque in hac certe *inductione* spes maxima sita est.

CVI.

At in axiomatibus constituendis per hanc inductionem, examinatio et probatio etiam facienda est, utrum quod constituitur axioma aptatum sit tantum, et ad mensuram factum eorum particularium, ex quibus extrahitur; an vero sit amplius et latius[30]. Quod si sit amplius aut latius, videndum, an eam suam amplitudinem et latitudinem, per novorum particularium designationem, quasi fidejussione quadam firmet; ne vel in jam notis tantum hæreamus, vel laxiore fortasse complexu, umbras et formas abstractas, non solida et determinata in materia, prensemus. Hæc vero cum in usum venerint, solida tum demum spes merito affulserit.

CVII.

Atque hic etiam resumendum est, quod superius[31]

[30] Even after the introduction of the new system, jealous heed must be taken lest Axioms be hastily or falsely assumed. For then we should warp facts into unity with our theories, which is a fatal error in Physical Science, and not without its disadvantages in Morals and Politics.

[31] Cf. I. 103. This work of connecting a general system of Natural Philosophy with particular Sciences makes progress whenever such general principles as that of Gravitation, or of the propagation of Light and Sound, are discovered. The Ancient system of commencing with *Ens* and working down by differences to each Science, is, of course, the last thing that Bacon would in-

dictum est de naturali philosophia producta, et scientiis particularibus ad eam reductis, ut non fiat scissio et truncatio scientiarum; nam etiam absque hoc, minus de progressu sperandum est.

CVIII.

Atque de desperatione tollenda, et spe facienda, ex præteriti temporis erroribus valere jussis, aut rectificatis, jam dictum est. Videndum autem et si quæ alia sint, quæ spem faciant. Illud vero occurrit; si hominibus non quærentibus, et aliud agentibus, multa utilia, tanquam casu quodam, aut per occasionem, inventa sint; nemini dubium esse posse, quin iisdem quærentibus, et hoc agentibus, idque via et ordine, non impetu et desultorie, longe plura detegi necesse sit. Licet enim semel aut iterum accidere possit, ut quispiam in id forte fortuna incidat, quod magno conatu et de industria scrutantem antea fugit; tamen in summa rerum proculdubio contrarium invenitur. Itaque longe plura, et meliora, atque per minora intervalla, a ratione et industria, et directione, et intentione hominum, speranda sunt, quam a casu, et instinctu animalium, et hujusmodi, quæ hactenus principium inventis dederunt[32].

CIX.

Etiam illud ad spem trahi possit, quod nonnulla ex

tend. Such books as Herschel's Discourse on Natural Philosophy form the best comment on his meaning.

[32] And yet even now how many great discoveries are due to chance. Steam, for example. In the application of our discoveries, however, modern times are far more fruitful than the ancient would have been; for we have grown vastly in *ingenuity*, if we have not in *genius*. The Baconian Form not having been discovered, his remarks on the growth of knowledge by its means must always be overstrained. Man's office as *interpreter of Nature* must be more limited than Bacon believed it to be: but at the same time it allows of greater varieties of power and skill than he thought possible. For modern Physics do anything rather than level intellects.

his, quæ jam inventa sunt, ejus sint generis, ut, antequam invenirentur, haud facile cuiquam in mentem venisset, de iis aliquid suspicari; sed plane quis illa ut impossibilia contempsisset. Solent enim homines de rebus novis ad exemplum veterum, et secundum phantasiam ex iis præceptam et inquinatam, hariolari; quod genus opinandi fallacissimum est, quandoquidem multa ex his, quæ ex fontibus rerum petuntur, per rivulos consuetos non fluant.

Veluti si quis, ante tormentorum igneorum[33] inventionem, rem per effectus descripsisset, atque in hunc modum dixisset; inventum quoddam detectum esse, per quod muri, et munitiones quæque maximæ, ex longo intervallo concuti et dejici possint; homines sane de viribus tormentorum et machinarum, per pondera, et rotas, et hujusmodi arietationes et impulsus multiplicandis, multa et varia secum cogitaturi fuissent; de vento autem igneo, tam subito et violenter se expandente et exsufflante, vix unquam aliquid alicujus imaginationi, aut phantasiæ, occursurum fuisset; utpote cujus exemplum in proximo non vidisset, nisi forte in terræ motu, aut fulmine, quæ ut magnalia naturæ, et non imitabilia ab homine, homines statim rejecturi fuissent.

Eodem modo, si ante fili bombycini[34] inventionem, quispiam hujusmodi sermonem injecisset; esse quoddam fili genus inventum, ad vestium et supellectilis usum, quod filum linteum aut laneum tenuitate, et nihilominus tenacitate, ac etiam splendore et mollitie, longe superaret; homines statim aut de serico aliquo vegetabili, aut de animalis alicujus pilis delicatioribus, aut de avium plumis et lanugine, aliquid opinaturi

[33] Cannon. [34] Silk.

fuissent; verum de vermis pusilli textura, eaque tam copiosa, et se renovante, et anniversaria, nil fuissent certe commenturi. Quod si quis etiam de vermi verbum aliquod injecisset, ludibrio certe futurus fuisset, ut qui novas aranearum operas somniaret.

Similiter, si ante inventionem acus nauticæ[35], quispiam hujusmodi sermonem intulisset; inventum esse quoddam instrumentum, per quod cardines et puncta cœli exacte capi et dignosci possint; homines statim de magis exquisita fabricatione instrumentorum astronomicorum ad multa et varia, per agitationem phantasiæ, discursuri fuissent: quod vero aliquid inveniri possit, cujus motus cum cœlestibus tam bene conveniret[36], atque ipsum tamen ex cœlestibus non esset, sed tantum substantia lapidea, aut metallica; omnino incredibile visum fuisset. Atque hæc tamen, et similia, per tot mundi ætates, homines latuerunt, nec per philosophiam, aut artes rationales inventa sunt, sed casu, et per occasionem; suntque illius (ut diximus) generis, ut ab iis, quæ antea cognita fuerunt, plane heterogenea et remotissima sint, ut prænotio aliqua nihil prorsus ad illa conducere potuisset.

Itaque sperandum omnino est[37], esse adhuc in naturæ sinu multa excellentis usus recondita, quæ nullam cum jam inventis cognationem habent, aut parallelismum; sed omnino sita sunt extra vias phantasiæ; quæ tamen adhuc inventa non sunt; quæ proculdubio per multos sæculorum circuitus et ambages et ipsa quando-

[35] The Magnetic needle and the Mariner's compass.

[36] Here is one of Bacon's weak points. It had been well had he despised Gilbert a little less, and learned a little more from him.

[37] This hope has been already amply fulfilled in such discoveries as Steam, Electricity (and the Electric Telegraph, which is an application), the Chronometer, &c. And are there not many more hidden gifts of Nature which may before long be brought out for the use of man?

que prodibunt, sicut illa superiora prodierunt; sed per viam, quam nunc tractamus, propere, et subito, et simul repræsentari, et anticipari possunt.

CX.

Attamen conspiciuntur et alia inventa ejus generis, quæ fidem faciant, posse genus humanum nobilia inventa, etiam ante pedes posita, præterire et transilire. Utcunque enim pulveris tormentarii, vel fili bombycini, vel acus nauticæ, vel sacchari, vel papyri, vel similium inventa, quibusdam rerum et naturæ proprietatibus niti videantur; at certe imprimendi artificium nil habet, quod non sit apertum et fere obvium. Et nihilominus homines, non advertentes literarum modulos difficilius scilicet collocari, quam literæ per motum manus scribantur, sed hoc interesse, quod literarum moduli semel collocati, infinitis impressionibus, literæ autem per manum exaratæ, unicæ tantum scriptioni sufficiant; aut fortasse iterum non advertentes, atramentum ita inspissari posse, ut tingat, non fluat; præsertim literis resupinatis, et impressione facta desuper; hoc pulcherrimo invento (quod ad doctrinarum propagationem tantum facit) per tot sæcula caruerunt.

Solet autem mens humana, in hoc inventionis curriculo, tam læva sæpenumero et male composita esse, ut primo diffidat, et paulo post se contemnat; atque primo incredibile ei videatur, aliquid tale inveniri posse; postquam autem inventum sit, incredibile rursus videatur, id homines tamdiu fugere potuisse[38]. Atque hoc ipsum ad spem rite trahitur; superesse nimirum adhuc magnum

[38] Cf. supra, I. 97. We can hardly realise the time when (e. g.) machinery was unknown. The Astronomer can hardly imagine himself ignorant of the Elliptical form of all Orbits, and the Laws of Force. This passage reminds us of Seneca's "Veniet tempus, quo posteri nostri tam aperta nos nescisse mirentur."

inventorum cumulum, qui non solum ex operationibus incognitis eruendis, sed et ex jam cognitis tranferendis, et componendis, et applicandis, per eam, quam diximus experientiam literatam, deduci possit[39].

CXI.

Neque illud omittendum ad faciendam spem: reputent (si placet) homines infinitas ingenii, temporis, facultatum expensas, quas homines in rebus et studiis longe minoris usus et pretii collocant; quorum pars quota si ad sana et solida verteretur, nulla non difficultas superari possit. Quod idcirco adjungere visum est, quia plane fatemur, historiæ naturalis et experimentalis collectionem, qualem animo metimur[40], et qualis esse debet, opus esse magnum, et quasi regium, et multæ operæ atque impensæ.

CXII.

Interim particularium multitudinem nemo reformidet, quin potius hoc ipsum ad spem revocet. Sunt enim artium et naturæ particularia *phænomena* manipuli instar ad ingenii commenta, postquam ab evidentia rerum disjuncta et abstracta fuerint[41]. Atque hujus viæ exitus in aperto est, et fere in propinquo; alterius exitus nullus, sed implicatio infinita. Homines enim adhuc parvam in experientia moram fecerunt, et eam leviter perstrinxerunt, sed in meditationibus et commentationibus ingenii infinitum tempus contriverunt. Apud nos vero si esset præsto quispiam, qui de

[39] "Ex operationibus incognitis"—such (e. g.) as Electricity: "ex jam cognitis"—such as the application of certain acids to the bleaching of linen.

[40] This collection was intended to form the third part of the Instauration. Of this, however, he only completed two sections out of six; viz. the *Historia Ventorum* and the *Historia Vitæ et Mortis*.

[41] This refers to the principle of Selection of Suitable Instances—"Prerogatives."

facto naturæ ad interrogata responderet[42], paucorum annorum esset inventio causarum et scientiarum omnium.

CXIII.

Etiam nonnihil hominibus spei fieri posse putamus ab exemplo nostro proprio[43]; neque jactantiæ causa hoc dicimus, sed quod utile dictu sit. Si qui diffidant, me videant, hominem inter homines ætatis meæ civilibus negotiis occupatissimum, nec firma admodum valetudine, (quod magnum habet temporis dispendium) atque in hac re plane *protopirum*, et vestigia nullius sequutum, neque hæc ipsa cum ullo mortalium communicantem; et tamen veram viam constanter ingressum, et ingenium rebus submittentem, hæc ipsa aliquatenus (ut existimamus) provexisse: et deinceps videant, quid ab hominibus otio abundantibus, atque a laboribus consociatis, atque a temporum successione, post hæc indicia nostra expectandum sit; præsertim in via, quæ non singulis solummodo pervia est (ut fit in via illa rationali), sed ubi hominum labores et operæ (præsertim quantum ad experientiæ collectam) optime distribui, et deinde componi possint. Tum enim homines vires suas nosse incipient, cum non eadem infiniti, sed alia alii præstabunt[44].

[42] i. e. Any one to answer our questions and tell us what the fact is, and what the result would be, without our having the hindrance and difficulty of going through each particular experiment. Here too peeps out Bacon's sanguine hope for knowledge. He evidently hoped for some such result to follow upon the application of his new Method.

[43] Bacon's reference to himself in this place is perfectly just. What man before or after has had such insight into all branches of science (compared with the existing state of knowledge), and at the same time has been so actively employed in the affairs of social life?

[44] Here is the germ of the modern principle of "Division of Labour" so well drawn out by Adam Smith in the beginning of his Wealth of Nations. In this, as in other things, increased swiftness brings with it a risk of want of stability. Division of Labour has a very

CXIV.

Postremo, etiamsi multo infirmior et obscurior aura spei ab *ista nova continente* spiraverit; tamen omnino experiendum esse (nisi velimus animi esse plane abjecti) statuimus. Non enim res pari periculo non tentatur, et non succedit[45]; cum in illo, ingentis boni; in hoc, exiguæ humanæ operæ jactura vertatur. Verum ex dictis, atque etiam ex non dictis, visum est nobis, spei abunde subesse, non tantum homini strenuo ad experiendum, sed etiam prudenti et sobrio ad credendum.

CXV.

Atque de desperatione tollenda, quæ inter causas potentissimas ad progressum scientiarum remorandum et inhibendum fuit, jam dictum est: atque simul sermo de signis et causis errorum, et inertiæ, et ignorantiæ, quæ invaluit, absolutus est; præsertim cum subtiliores causæ, et quæ in judicium populare aut observationem non incurrant, ad ea, quæ de *idolis* animi humani dicta sunt, referri debeant.

Atque hic simul pars destruens[46] *Instaurationis* no-

narrowing tendency on the minds of those who are engaged on it—a tendency met to a certain extent in cities by the greater facilities for mental cultivation and social intercourse: but still helping, on that development of quick but one-sided knowledge, which we must regard with fear. A man who is accustomed to one narrow sphere of work must gradually become incapable of general and broader views. He who has to point needles all his life, is not unlikely to have a sharp but partial view of things. This evil corresponds to that referred to above (I. 88), where Bacon speaks of the error of considering one subject absolutely by itself.

[45] This is the principle applied by Bp. Butler in the Analogy, to the chances in favour of Christianity being true. If we neglect it, we run the risk of losing a great, an immeasurable good, without any gain. If we embrace it, we do but run the little risk (and is the risk not in itself a good?) of a short watchfulness, and of some self-denial, and if it be true, how the gain outweighs the toil! A low argument; but one having weight with some minds.

[46] "Pars destruens"—the negative part: in which Bacon still succeeds in introducing much that is quite *constructive*—as e. g. I. 103–106.

stræ claudi debet, quæ perficitur tribus redargutionibus; redargutione nimirum *humanæ rationis nativæ*, et sibi permissæ; redargutione *demonstrationum*; et redargutione *theoriarum*, sive philosophiarum, et doctrinarum, quæ receptæ sunt. Redargutio vero earum talis fuit, qualis esse potuit; videlicet per signa, et evidentiam causarum; cum confutatio alia nulla a nobis (qui et de principiis, et de demonstrationibus, ab aliis dissentimus) adhiberi potuerit.

Quocirca tempus est, ut ad ipsam artem et normam *interpretandi naturam* veniamus; et tamen nonnihil restat, quod prævertendum est. Quum enim in hoc primo *aphorismorum* libro illud nobis propositum sit, ut tam ad intelligendum, quam ad recipiendum ea, quæ sequuntur, mentes hominum præparentur; expurgata jam, et abrasa, et æquata mentis area, sequitur ut mens sistatur in positione bona, et tanquam aspectu benevolo, ad ea quæ proponemus. Valet enim in re nova ad præjudicium, non solum præoccupatio fortis opinionis veteris, sed et præceptio sive præfiguratio falsa rei, quæ affertur. Itaque conabimur efficere, ut habeantur bonæ et veræ, de iis quæ adducimus, opiniones, licet ad tempus tantummodo, et tanquam usurariæ, donec res ipsa pernoscatur.

CXVI.

Primo itaque postulandum videtur[47], ne existiment homines, nos, more antiquorum Græcorum, aut quorundam novorum hominum, Telesii, Patricii, Severini[48],

[47] These preparatory remarks are a kind of διαβολῆς λύσις, to clear away prejudices and objections against the new method.

[48] *Bernardino Telesio* was a native of Cosenza, born in 1509. He published a treatise "De Natura Rerum juxta propria Principia." His system was that of the antagonism of two incorporeal principles, Heat and Cold, struggling for the dominion over a third principle, viz. passive matter. His views were not unlike those of Parmenides.

sectam aliquam in philosophia condere velle: neque enim hoc agimus, neque etiam multum interesse putamus ad hominum fortunas, quales quis opiniones abstractas de natura et rerum principiis habeat: neque dubium est, quin multa hujusmodi, et vetera revocari, et nova introduci possint; quemadmodum et complura themata cœli supponi possunt, quæ cum *phænomenis* sat bene conveniunt, inter se tamen dissentiunt.

At nos de hujusmodi rebus opinabilibus, et simul inutilibus, non laboramus. At contra nobis constitutum est experiri, an revera potentiæ et amplitudinis humanæ firmiora fundamenta jacere, ac fines in latius proferre possimus. Atque licet sparsim, et in aliquibus subjectis specialibus, longe veriora habeamus, et certiora, (ut arbitramur) atque etiam magis fructuosa, quam quibus homines adhuc utuntur, (quæ in quintam *Instaurationis* nostræ partem congessimus[49]) tamen

See Hallam's Lit. of Europe, part II. chap. iii. § 9–10.

Francesco Patrisio was a native of Cherso in Dalmatia, born in 1529. He published a treatise against Aristotle, under the title of "Nova de Universis Philosophia."

Marco Aurelio Severino was a physician. He was born in Calabria, and practised at Naples; he, too, wrote against Aristotle. All these three were nearly contemporary with Bacon.

[49] It is a remarkable fact that not one of the six Parts of the *Instauratio* was ever completed; unless it were the first, which is entitled by Bacon, "Partitiones Scientiarum," and which is equivalent to the "De Augmentis Scientiarum," which he lengthened to its present size from the shorter treatise on the Advancement of Learning. The Second Part also received a large share of attention: for it includes the Nov. Org., which however is unfinished. Of the Third Part we have much remaining—chiefly in a fragmentary state. The Parasceue, and the different collections of Natural History belong to it. Of the Fourth Part we seem to have nothing except the "Scala Intellectus sive Filum Labyrinthi:" the fuller development of the principles stated supra, I. 103—106. The Fifth Part here mentioned is entitled "Prodromi sive Anticipationes Philosophiæ Secundæ," and would seem to be introductory to the Sixth Part. Of it we have nothing definitely remaining: unless it be the Preface. And, lastly, the Sixth Part—the Second Philosophy—to which all the other five were to be subservient and ministerial, was, as he says here, and also in the *Distributio*,

theoriam nullam universalem, aut integram proponimus. Neque enim huic rei tempus adhuc adesse videtur. Quin nec spem habemus vitæ producendæ, ad sextam *Instaurationis* partem (quæ philosophiæ, per legitimam naturæ interpretationem inventæ, destinata est) absolvendam; sed satis habemus, si in mediis sobrie et utiliter nos geramus, atque interim semina veritatis sincerioris in posteros spargamus, atque initiis rerum magnarum non desimus.

CXVII.

Atque quemadmodum sectæ conditores non sumus; ita nec operum particularium largitores, aut promissores[50]. Attamen possit aliquis hoc modo occurrere; quod nos, qui tam sæpe operum mentionem faciamus, et omnia eo trahamus, etiam operum aliquorum pignora exhibeamus. Verum via nostra et ratio (ut sæpe perspicue diximus, et adhuc dicere juvat) ea est; ut non opera ex operibus, sive experimenta ex experimentis, (ut empirici) sed ex operibus et experimentis causas et axiomata, atque ex causis et axiomatibus rursus nova opera et experimenta (ut legitimi naturæ interpretes) extrahamus.

Atque licet in tabulis nostris inveniendi, (ex quibus

beyond both his strength and his hopes. He never attempted it. The scheme is magnificent, and though posterity have not carried it out as he sketched it, and though his "Methodus Scientiarum" is not strictly followed, yet no fair mind will refuse him the honour of having seen so glorious a prospect, and yet of having refrained from hastening on to enjoy a fancied happiness in that "New Continent" which he descried: of having discovered much, and yet of his having been willing to spend his life in making preparations for the safe and better entrance of others into the reward of his wisdom and labours.

[50] Still no promise of particular results or "fruit." Bacon is anxious first to build up his Method, not in itself an end, but a means through which results may be for ever newly attained. So above, he has the same thought, and the same illustration from Atalanta. Cf. I. 70, and 121.

quarta pars *Instaurationis* consistit) atque etiam exemplis particularium, (quæ[51] in secunda parte adduximus) atque insuper in observationibus nostris super historiam, (quæ in tertia parte operis descripta est) quivis vel mediocris perspicaciæ et solertiæ, complurium operum nobilium indicationes et designationes ubique notabit; ingenue tamen fatemur, historiam naturalem, quam adhuc habemus, aut ex libris, aut ex inquisitione propria, non tam copiosam esse et verificatam, ut legitimæ interpretationi satisfacere aut ministrare possit.

Itaque si quis ad mechanica sit magis aptus et paratus, atque sagax ad venanda opera, ex conversatione sola cum experimentis, ei permittimus et relinquimus illam industriam, ut ex historia nostra et tabulis multa, tanquam in via, decerpat et applicet ad opera, ac veluti fœnus recipiat ad tempus, donec sors haberi possit. Nos vero, cum ad majora contendamus, moram omnem præproperam et præmaturam in istiusmodi rebus, tanquam Atalantæ pilas (ut sæpius solemus dicere) damnamus. Neque enim aurea poma pueriliter affectamus, sed omnia in victoria cursus artis super naturam ponimus[52]; neque muscum aut segetem herbidam demetere festinamus, sed messem tempestivam expectamus.

CXVIII.

Occurret etiam alicui proculdubio, postquam ipsam historiam nostram et inventionis tabulas perlegerit, ali-

[51] For "quas" depending on "particularium," I read "quæ" depending on "exemplis,"—following the Errata to the Ed. 1620.

[52] This is obscure. Some doubt the correctness of the reading, but there is no authority for any other. Wood's translation of the passage is absolutely opposed to the truth, as though Bacon would ever wish to make "the course of Art *outstrip* Nature." It seems to mean; "we do not hasten to gather unripe results, but rest everything upon the victory which systematic Art (such seems to be the sense of *Cursus Artis*) will gain over Nature; so shall we obtain not the unfit moss, or green blade of corn, but the perfect and seasonable harvest."

quid in ipsis experimentis minus certum, vel omnino falsum; atque propterea secum fortasse reputabit, fundamentis et principiis falsis et dubiis inventa nostra niti. Verum hoc nihil est; necesse enim est, talia sub initiis evenire. Simile enim est, ac si in scriptione, aut impressione, una forte litera, aut altera, perperam posita aut collocata sit; id enim legentem non multum impedire solet, quandoquidem errata ab ipso sensu facile corriguntur. Ita etiam cogitent homines, multa in historia naturali experimenta falso credi et recipi posse; quæ paulo post a causis et axiomatibus inventis facile expunguntur et rejiciuntur. Sed tamen verum est, si in historia naturali, et experimentis, magna, et crebra, et continua fuerint errata, illa nulla ingenii aut artis felicitate corrigi aut emendari posse. Itaque si in historia nostra naturali, quæ tanta diligentia, et severitate, et fere religione probata et collecta est, aliquid in particularibus quandoque subsit falsitatis, aut erroris; quid tandem de naturali historia vulgari, quæ præ nostra tam negligens est et facilis, dicendum erit? aut de philosophia et scientiis super hujusmodi arenas (vel syrtes potius) ædificatis? Itaque hoc, quod diximus, neminem moveat[53].

CXIX.

Occurrent etiam in historia nostra et experimentis

[53] This is a wise axiom: and administers a rebuke to such eager critics as Le Maistre. We shall have, of course, to notice continual errors in Bacon's Physical Knowledge; errors which to us seem strange, but in his day were pardonable, and sometimes praiseworthy. —These errors no how vitiate his principles; and no one would more gladly have corrected them than Bacon himself. It is one of the functions of a growing Philosophy to accept the good, and to eliminate the faults of all who have before written; and so it comes that most works on Physics are obsolete in a few years. But it is the glory of this work that no course of years can render it obsolete, and that as Physical Sciences flourish, it will obtain more and more respect; for its general principles will stand, and its insight into Nature is deep; and often its very faults are instructive.

plurimæ res; primo leves et vulgatæ, deinde viles et illiberales, postremo nimis subtiles ac mere speculativæ, et quasi nullius usus: quod genus rerum hominum studia avertere et alienare possit.

Atque de istis rebus, quæ videntur vulgatæ, illud homines cogitent; solere sane eos adhuc nihil aliud agere, quam ut eorum, quæ rara sunt, causas ad ea, quæ frequenter fiunt, referant et accommodent: at ipsorum, quæ frequenter eveniunt, nullas causas inquirant, sed ea ipsa recipiant tanquam concessa et admissa[54].

Itaque non ponderis, non rotationis cœlestium, non caloris, non frigoris, non luminis, non duri, non mollis, non tenuis, non densi, non liquidi, non consistentis, non animati, non inanimati, non similaris, non dissimilaris, nec demum organici causas quærunt; sed, illis tanquam pro evidentibus et manifestis receptis, de cæteris rebus, quæ non tam frequenter et familiariter occurrunt, disputant et judicant.

Nos vero, qui satis scimus, nullum de rebus raris aut notabilibus judicium fieri posse, multo minus res novas in lucem protrahi, absque vulgarium rerum causis, et causarum causis rite examinatis et repertis; necessario ad res vulgarissimas in historiam nostram recipiendas compellimur. Quinetiam nil magis philosophiæ offecisse deprehendimus, quam quod res, quæ familiares sunt, et frequenter occurrunt, contemplationem hominum non morentur et detineant, sed recipiantur obiter, neque earum causæ quæri soleant: ut non sæpius requiratur informatio de rebus ignotis, quam attentio in notis.

54 There is great wisdom in thus calling attention to "common things." It is a part of Bacon's system to make Philosophy useful to ordinary life "ut dotetur vita humana novis inventis et copiis." I. 81.

CXX.

Quod verò ad rerum vilitatem attinet, vel etiam turpitudinem, quibus (ut ait Plinius[55]) honos præfandus est; eæ res, non minus quam lautissimæ et pretiosissimæ, in historiam naturalem recipiendæ sunt. Neque propterea polluitur naturalis historia: sol enim æque palatia et cloacas ingreditur, neque tamen polluitur. Nos autem non capitolium aliquod aut pyramidem hominum superbiæ dedicamus aut condimus, sed templum sanctum ad exemplar mundi in intellectu humano fundamus. Itaque exemplar sequimur. Nam quicquid essentia dignum est, id etiam scientia dignum, quæ est essentiæ imago[56]. At vilia æque subsistunt, ac lauta. Quinetiam, ut e quibusdam putridis materiis, veluti musco et zibetho, aliquando optimi odores generantur; ita et ab instantiis vilibus et sordidis quandoque eximia lux et informatio emanant. Verum de hoc nimis multa; cum hoc genus fastidii sit plane puerile et effœminatum.

CXXI.

At de illo omnino magis accurate dispiciendum; quod plurima in historia nostra captui vulgari, aut etiam cuivis intellectui, (rebus præsentibus assuefacto) videbuntur curiosæ cujusdam et inutilis subtilitatis. Itaque de hoc ante omnia et dictum et dicendum est. Hoc scilicet; nos, jam sub initiis et ad tempus, tantum *lucifera*[57] experimenta, non *fructifera* quærere; ad ex-

[55] Pliny, Nat. Hist. XI. 2. Rerum natura nusquam magis quam in minimis tota est. Quapropter, quæso, ne hæc legentes, quoniam ex his spernunt multa, etiam relata fastidio damnent, cum in contemplatione naturæ nihil possit videri supervacuum.

[56] A fine and brief description of Knowledge. Taking *essentia* in its widest sense, this would stand for a description of Truth itself, as it is known to us.

[57] Cf. I. 70. 99. 117.
The first period of Induction is as little fruitful as the seed-sowing is; for in Physics, as in all else, there is need of "Faith and Patience." We

emplum creationis divinæ, quod sæpius diximus, quæ primo die lucem tantum produxit, eique soli unum integrum diem attribuit, neque illo die quicquam materiati operis immiscuit.

Itaque si quis istiusmodi res nullius esse usus putet, idem cogitat ac si nullum etiam lucis esse usum censeat, quia res scilicet solida aut materiata non sit. Atque revera dicendum est, simplicium naturarum cognitionem bene examinatam et definitam instar lucis esse; quæ ad universa operum penetralia aditum præbet; atque tota agmina operum et turmas, et axiomatum nobilissimorum fontes, potestate quadam complectitur, et post se trahit; in se tamen non ita magni usus est. Quin et literarum elementa per se et separatim nihil significant, nec alicujus usus sunt; sed tamen ad omnis sermonis compositionem et apparatum instar materiæ primæ sunt. Etiam semina rerum, potestate valida, usu (nisi in processu suo) nihili sunt. Atque lucis ipsius radii dispersi, nisi coeant, beneficium suum non impertiuntur.

Quod si quis subtilitatibus speculativis offendatur; quid de scholasticis viris dicendum erit, qui subtilitatibus immensum indulserunt? Quæ tamen subtilitates in verbis, aut saltem vulgaribus notionibus, (quod tantundem valet) non in rebus aut natura consumptæ fuerunt; atque utilitatis expertes erant, non tantum in origine, sed etiam in consequentiis: tales autem non fuerunt, ut haberent in præsens utilitatem nullam, sed

must keep clear from the impatience which follows nothing but that whose knowledge brings immediate fruit, or that which produces only the unprofitable and hurtful thorns of dispute. So Bacon's "subtilitas" in this Aphorism is not one of argument or wit, nor of words; but a keen insight into facts; a quickness in detecting and rejecting wrong instances; a readiness at sifting and investigating; a sharpness at seeing resemblances and differences; a skill of classification.

per consequens infinitam; quales sunt eæ de quibus loquimur. Hoc vero sciant homines pro certo, omnem subtilitatem disputationum et discursuum mentis, si adhibeatur tantum post axiomata inventa, seram esse et præposteram: et subtilitatis tempus verum ac proprium, aut saltem præcipuum, versari in pensitanda experientia, et inde constituendis axiomatibus: nam illa altera subtilitas naturam prensat et captat, sed nunquam apprehendit aut capit. Et verissimum certe est, quod de occasione sive fortuna dici solet, si transferatur ad naturam: videlicet, *eam a fronte comatam, ab occipitio calvam esse*[58].

Denique de contemptu in naturali historia rerum aut vulgarium, aut vilium, aut nimis subtilium, et in originibus suis inutilium, illa vox mulierculæ ad tumidum principem, qui petitionem ejus, ut rem indignam et majestate sua inferiorem, abjecisset, pro oraculo sit; *Desine ergo rex esse*[59]*:* quia certissimum est, imperium in naturam, si quis hujusmodi rebus, ut nimis exilibus et minutis, vacare nolit, nec obtineri nec geri posse.

CXXII.

Occurrit etiam et illud; mirabile quiddam esse et durum, quod nos omnes scientias atque omnes auctores simul, ac veluti uno ictu et impetu, summoveamus: idque non assumpto aliquo ex antiquis in auxilium et præsidium nostrum, sed quasi viribus propriis.

Nos autem scimus, si minus sincera fide agere voluissemus, non difficile fuisse nobis, ista, quæ afferuntur,

[58] This thought is found in one of the fables of Phædrus, v. 8, on "Occasio Depicta." Also there is a Hexameter found in Dionysius Cato, Distich. de Moribus II. 26. (circ. A. D. 400.)

"Fronte capillata, post est Occasio calva."

This is of course the Latin form of our proverb about "taking Time by the forelock."

[59] Told of Philip of Macedon.

vel ad antiqua sæcula ante Græcorum tempora, (cum scientiæ de natura magis fortasse, sed tamen majore cum silentio, floruerint; neque in Græcorum tubas et fistulas[60] adhuc incidissent) vel etiam (per partes certe) ad aliquos ex Græcis ipsis referre, atque astipulationem et honorem inde petere: more novorum hominum, qui nobilitatem sibi ex antiqua aliqua prosapia, per genealogiarum favores, astruunt et affingunt. Nos vero rerum evidentia freti, omnem commenti et imposturæ conditionem rejicimus, neque ad id quod agitur plus interesse putamus, utrum, quæ jam invenientur, antiquis olim cognita, et per rerum vicissitudines et sæcula occidentia et orientia sint; quam, hominibus curæ esse debere, utrum novus orbis fuerit insula illa Atlantis[61], et veteri mundo cognita; an nunc primum reperta. Rerum enim inventio a naturæ luce petenda, non ab antiquitatis tenebris repetenda est.

Quod vero ad universalem istam reprehensionem attinet, certissimum est vere rem reputanti, eam et magis probabilem esse, et magis modestam, quam si facta fuisset ex parte. Si enim in primis notionibus errores radicati non fuissent, fieri non potuisset, quin nonnulla recte inventa, alia perperam inventa correxissent. Sed cum errores fundamentales fuerint, atque ejusmodi, ut homines potius res neglexerint ac præterierint, quam de illis pravum aut falsum judicium fecerint; minime mirum est, si homines id non obtinuerint, quod non egerint; nec ad metam pervenerint,

[60] Referring to the music to which the Greek armies were wont to march.

—— "anon they move
In perfect phalanx to the Dorian mood
Of flutes and soft recorders: such as raised
To height of noblest temper heroes old
Arming to battle. Milton, Par. Lost. I. 549.

[61] See Plato, Tim. 25. a—seqq.

quam non posuerint aut collocarint; neque viam emensi sint, quam non ingressi sint aut tenuerint.

Atque insolentiam rei quod attinet; certe si quis manus constantia atque oculi vigore lineam magis rectam, aut circulum magis perfectum se describere posse, quam alium quempiam, sibi assumat; inducitur scilicet facultatis comparatio: quod si quis asserat, se, adhibita regula, aut circumducto circino, lineam magis rectam, aut circulum magis perfectum posse describere, quam aliquem alium vi sola oculi et manus; is certe non admodum jactator fuerit. Quin hoc, quod dicimus, non solum in hoc nostro conatu primo et inceptivo locum habet; sed etiam pertinet ad eos, qui huic rei posthac incumbent. Nostra enim via inveniendi scientias exæquat fere ingenia [62], et non multum excellentiæ eorum relinquit: cum omnia per certissimas regulas et demonstrationes transigat. Itaque hæc nostra (ut sæpe diximus) felicitatis cujusdam sunt potius quam facultatis, et potius temporis partus [63] quam ingenii. Est enim certe casus aliquis non minus in cogitationibus humanis, quam in operibus et factis.

CXXIII.

Itaque dicendum de nobis ipsis quod ille per jocum dixit, præsertim cum tam bene rem secet: *Fieri non potest ut idem sentiant, qui aquam, et qui vinum bibant* [64]. At cæteri homines, tam veteres quam novi, liquorem biberunt crudum in scientiis, tanquam aquam, vel sponte ex intellectu manantem, vel per dialecti-

[62] This, as we have before noticed, has never followed from the growth of Physical Philosophy. (Cf. supr. I. 108.) Had an exact Method, such as Bacon seems to have hoped for, been possible, this result might have taken place: but there is as much play for ability now, and as strong a distinction between men's powers, as ever there was.

[63] Cf. supr. I. 78. Also I. 97.

[64] The saying of Philocrates about Demosthenes.

cam, tanquam per rotas ex puteo haustam. At nos liquorem bibimus et propinamus ex infinitis confectum uvis, iisque maturis et tempestivis, et per racemos quosdam collectis ac decerptis; subinde in torculari pressis, ac postremo in vase repurgatis et clarificatis. Itaque nil mirum, si nobis cum aliis non conveniat.

CXXIV.

Occurret proculdubio et illud: nec metam aut scopum scientiarum a nobis ipsis (id quod in aliis reprehendimus) verum et optimum præfixum esse. Esse enim contemplationem veritatis omni operum utilitate et magnitudine digniorem et celsiorem: longam vero istam et sollicitam moram in experientia et materia, et rerum particularium fluctibus, mentem veluti humo affigere, vel potius in Tartarum quoddam confusionis et perturbationis dejicere; atque ab abstractæ sapientiæ serenitate et tranquillitate (tanquam a statu multo diviniore[65]) arcere et summovere. Nos vero huic rationi libenter assentimur; et hoc ipsum, quod innuunt ac præoptant, præcipue atque ante omnia agimus. Etenim verum exemplar mundi in intellectu humano fundamus; quale invenitur, non quale cuipiam sua propria ratio dictaverit. Hoc autem perfici non potest, nisi facta mundi dissectione atque anatomia diligentissima. Modulos vero ineptos mundorum et tanquam simiolas[66],

[65] This is both Platonic and Peripatetic. Cf. Arist. Eth. Nic. x. 7. The βίος θεωρητικὸς was described as a state undisturbed by moral storms or trials, in which man by pure contemplation approached the knowledge of things as they are, not as they seem; and grew more and more like to the Divine Nature, whose whole Being (according to Aristotle) is contemplative. Bacon's answer to this objection is excellent. A knowledge of Nature is also a knowledge of Truth. God is its Author; and by studying the "Ideas of the Divine Mind" we attain to a conception of what is true. "Truth and Utility" rather than "Utility and Progress" (as Macaulay reads it) were Bacon's watchwords. Cf. supr. I. 81.

[66] "Buffooneries." The word is not Latin.

quas in philosophiis phantasiæ hominum extruxerunt, omnino dissipandas edicimus. Sciant itaque homines, (id quod superius diximus) quantum intersit inter humanæ mentis *idola* et divinæ mentis ideas[67]. Illa enim nihil aliud sunt quam abstractiones ad placitum[68]: hæ autem sunt vera signacula creatoris super creaturas, prout in materia per lineas veras et exquisitas imprimuntur et terminantur. Itaque ipsissimæ res sunt (in hoc genere) veritas et utilitas; atque opera ipsa pluris facienda sunt, quatenus sunt veritatis pignora, quam propter vitæ commoda[69].

CXXV.

Occurret fortasse et illud: nos tanquam actum agere; atque antiquos ipsos eandem, quam nos, viam tenuisse[70]. Itaque verisimile putabit quispiam etiam nos, post tantum motum et molitionem, deventuros tandem ad aliquam ex illis philosophiis, quæ apud antiquos valuerunt. Nam et illos in meditationum suarum principiis vim et copiam magnam exemplorum et particularium paravisse; atque in commentarios, per locos et titulos, digessisse; atque inde philosophias suas et artes confecisse, et postea, re comperta, pronuntiasse; et exempla ad fidem et docendi lumen sparsim addidisse; sed particularium notas, et codicillos, ac commentarios suos in lucem edere, supervacuum et molestum putasse: ideoque fecisse, quod in ædificando fieri solet; nempe post ædificii structuram, machinas et

[67] Cf. supr. I. 23.

[68] Cf. supr. I. 104.

[69] This passage defends Bacon from any charge of utilitarianism. Results of Physical Science must be first sought, because they are pledges of Truth—because they shew that we are gaining some knowledge of God's World. The usefulness, the "vitæ commoda," will follow naturally.

[70] This is met also above, I. 104, 105.

Cf. also on this point Hallam's Lit. of Europe, part III. chap. iii. § 45.

scalas a conspectu amovisse. Neque aliter factum esse credere certe oportet. Verum nisi quis omnino oblitus fuerit eorum, quæ superius dicta sunt, huic objectioni (aut scrupulo potius) facile respondebit. Formam enim inquirendi et inveniendi apud antiquos et ipsi profitemur, et scripta eorum præ se ferunt. Ea autem non alia fuit, quam ut ab exemplis quibusdam et particularibus (additis notionibus communibus, et fortasse portione nonnulla ex opinionibus receptis, quæ maxime placuerunt) ad conclusiones maxime generales sive principia scientiarum advolarent; ad quorum veritatem immotam et fixam, conclusiones inferiores per media educerent ac probarent; ex quibus artem constituebant. Tum demum si nova particularia et exempla mota essent et adducta, quæ placitis suis refragarentur; illa aut per distinctiones, aut per regularum suarum explanationes, in ordinem subtiliter redigebant; aut demum per exceptiones grosso modo summovebant: at rerum particularium non refragantium causas ad illa principia sua laboriose et pertinaciter accommodabant[71]. Verum nec historia naturalis et experientia illa erat, quam fuisse oportebat (longe certe abest), et ista advolatio ad generalissima omnia perdidit.

CXXVI.

Occurret et illud; nos, propter inhibitionem quan-

[71] This is an evil against which Bacon struggled hard. And even now there is peril from "the spirit of System"—men find it so hard to be honest: and when they have arrived at the rest and quiet of a definite Law, the temptation to shut their eyes against whatever seems opposed to it, is immense. Of the better way of regarding "exceptions" a very good instance is to be found in the way in which Astronomers noticed the perturbations of Uranus—facts which apparently militated against the Laws of Planetary Motion. They did not explain away the fact; but sought its cause, and so discovered Neptune. The induction that had taught men the Law of Gravity was too strong to be overthrown by an apparent "Instantia in contrarium."

dam pronuntiandi, et principia certa ponendi, donec per medios gradus ad generalissima rite perventum sit; suspensionem quandam judicii tueri, atque ad *acatalepsiam* rem deducere [72]. Nos vero non *acatalepsiam*, sed *eucatalepsiam* meditamur et proponimus: sensui enim non derogamus, sed ministramus; et intellectum non contemnimus, sed regimus. Atque melius est scire quantum opus sit, et tamen nos non penitus scire putare, quam penitus scire nos putare, et tamen nil eorum, quæ opus est, scire [73].

CXXVII.

Etiam dubitabit quispiam potius quam objiciet; utrum nos de naturali tantum philosophia, an etiam de scientiis reliquis, logicis, ethicis, politicis, secundum viam nostram perficiendis, loquamur [74]. At nos certe

[72] Cf. supr. I. 89. To this objection an answer is to be found in such sayings of Bacon's as "If a man will begin with certainties, he shall end in doubts; but if he will be content to begin with doubts, he shall end in certainties." Adv. of Learning, p. 51.

[73] In this Bacon must have had the εἰρώνεια of Socrates before his eyes. See Apol. Socr. p. 21 &c. The Knowledge of our Ignorance is one of the chief and best forms of Knowledge: and one which grows upon wise men: as we see in the case of Sir Isaac Newton, and his saying that "he felt like a child gathering pebbles on the shore of an infinite ocean," &c.

[74] What are the limits of this Method? As it is intended to be purely Instrumental, why should it not be applicable to all subjects of Human Knowledge? Not that Bacon would have dreamed of superseding Revelation, as the Positivists would do, and declare that he wished to do: but that for all things which God has given Man to learn for himself, this Method is the best and surest. And though the Method now in use is not exactly such as Bacon expected, still his observations here are perfectly just, and apply to it. We may discuss inductively Logic, as the Analysis of certain Intellectual Phenomena: Ethics, as the study of our Moral Nature—(due regard being had to God's revealed will on certain Moral questions): Politics, as the study of the combinations of the Civil and the Social Life. The first of these is now rather Psychology, and (to a certain extent) Pathology, than Logic—and we need not fear any attempt to confuse Intellect with Brain, and so to introduce a materialist view of our Mental Powers; and perhaps no more legitimate sphere for Modern Induction can be found than this. The Constitution of Man's

de universis hæc, quæ dicta sunt, intelligimus: atque quemadmodum vulgaris logica, quæ regit res per syllogismum, non tantum ad naturales, sed ad omnes scientias pertinet; ita et nostra, quæ procedit per *inductionem*, omnia complectitur. Tam enim historiam et tabulas inveniendi conficimus de ira, metu, et verecun-

Intellectual Nature is based on certain almost invariable laws; and the differences are usually those of degree, not of kind, and here the researches of Medicine and of Philosophy combine.

For the second subject, Ethics, it is almost enough to refer to Bishop Butler's sermons; which are throughout a successful application of the Inductive principle. Upon this part of its application the Statistics so diligently gathered during the last few years will have great effect; so long as men keep from the error of trusting only to "Moral Averages." On this bear all records of crime, as well as all chronicles of virtuous and heroic deeds. At the same time, lest we should be tempted to fall into a Necessitarian view of Morals (than which nothing, can be more fatal to a good life, and moral improvement) we have the continual mystery of the Human Will before us. Who shall reduce its action to exact calculable rules? Who shall affirm the amount and kind of motive required for even the selfsame act in two different persons. Experiment too is very difficult in Morals; and from the hidden nature of each man's "heart"—(by which, we take it, is meant the internal motive power causing Moral Actions)—observation is almost as difficult. Still much may be done even here. And the Statistics mentioned above are a definite expression of certain facts in our Social economy, and belong to an intermediate position between Morals and Social Πολιτική. Nor is there any more ground for objecting to "Moral Averages" as in themselves levelling men; than there would be for saying that the Statistics of the averages of life determined the time of any individual's death. The only question of any difficulty respecting an Inductive treatment of Morals seems to be this—Does such a treatment mean that there are no *a priori*, i. e. no revealed principles of Moral guidance? It does not seem so at first sight: though, like all investigations into "intermediate Axioms," or "Second Causes," it must have a tendency towards leading men to rely on observation, and to forget the revealed Will of God. For Bacon's more expanded views on Morals see De Augm. Scient. Bk. vii. Cf. also supr. I. 80; and Hallam's Lit. of Europe, part III. chap. iii. § 67—75; also, Whewell on Induction, p. 77.

For the third subject, Politics, we have the facts of History for the past, and observation for the present. A very difficult matter, though, it is to rectify our Political principles: for nothing in this world is so full of error, or leads to so grave results as an attempt to draw out parallels in History, where the cases are apparently, and not really, analogous. See also Mill's Logic, Bk. VI. chap. ix. See Arnold's Thuc. vol. I. App.

dia, et similibus; ac etiam de exemplis rerum civilium: nec minus de motibus mentalibus memoriæ, compositionis et divisionis, judicii, et reliquorum, quam de calido et frigido, aut luce, aut vegetatione, aut similibus. Sed tamen cum nostra ratio *interpretandi*, post historiam præparatam et ordinatam, non mentis tantum motus et discursus, (ut logica vulgaris) sed et rerum naturam intueatur; ita mentem regimus, ut ad rerum naturam se, aptis per omnia modis, applicare possit. Atque propterea multa et diversa in doctrina *interpretationis* præcipimus, quæ ad subjecti, de quo inquirimus, qualitatem et conditionem, modum inveniendi nonnulla ex parte applicent.

CXXVIII.

At illud de nobis ne dubitare quidem fas sit; utrum nos philosophiam et artes et scientias, quibus utimur, destruere et demoliri cupiamus: contra enim, earum et usum et cultum et honores libenter amplectimur. Neque enim ullo modo officimus, quin istæ, quæ invaluerunt, et disputationes alant, et sermones ornent, et ad professoria munera ac vitæ civilis compendia adhibeantur et valeant; denique tanquam numismata quædam, consensu inter homines recipiantur[75]. Quinetiam significamus aperte ea, quæ nos adducimus, ad istas res non multum idonea futura; cum ad vulgi captum deduci omnino non possint, nisi per effecta et opera tantum. At hoc ipsum, quod de affectu nostro et bona voluntate erga scientias receptas dicimus, quam vere profiteamur, scripta nostra in publicum edita (præsertim libri *De progressu scientiarum*) fidem faciant. Itaque id verbis amplius vincere non conabimur. Illud interim constanter et diserte monemus, his modis, qui in usu

[75] Cf. Preface. Also supr. I. 35.

sunt, nec magnos in scientiarum doctrinis et contemplatione progressus fieri, nec illas ad amplitudinem operum deduci posse.

CXXIX.

Superest ut de finis excellentia pauca dicamus. Ea si prius dicta fuissent, votis similia videri potuissent: sed spe jam facta, et iniquis præjudiciis sublatis, plus fortasse ponderis habebunt. Quod si nos omnia perfecissemus et plane absolvissemus, nec alios in partem et consortium laborum subinde vocaremus; etiam ab hujusmodi verbis abstinuissemus, ne acciperentur in prædicationem meriti nostri. Cum vero aliorum industria acuenda sit, et animi excitandi atque accendendi; consentaneum est, ut quædam hominibus in mentem redigamus.

Primo itaque, videtur inventorum nobilium introductio inter actiones humanas longe primas partes tenere: id quod antiqua sæcula judicaverunt. Ea enim rerum inventoribus divinos honores tribuerunt: iis autem, qui in rebus civilibus merebantur, (quales erant urbium et imperiorum conditores, legislatores, patriarum a diuturnis malis liberatores, tyrannidum debellatores, et his similes) heroum tantum honores decreverunt. Atque certe si quis ea recte conferat, justum hoc prisci sæculi judicium reperiet. Etenim inventorum beneficia ad universum genus humanum pertinere possunt; civilia ad certas tantummodo hominum sedes: hæc etiam non ultra paucas ætates durant; illa quasi perpetuis temporibus. Atque status emendatio in civilibus non sine vi et perturbatione plerumque procedit: at inventa beant, et beneficium deferunt absque alicujus injuria aut tristitia.

Etiam inventa quasi novæ creationes sunt, et divinorum operum imitamenta, ut bene cecinit ille:

Primum frugiferos fœtus mortalibus ægris
Dididerunt quondam præstanti nomine Athenæ:
Et RECREAVERUNT vitam, legesque rogarunt.[76]

Atque videtur notatu dignum in Salomone; quod cum imperio, auro, magnificentia operum, satellitio, famulitio, classe insuper, et nominis claritate, ac summa hominum admiratione floreret; tamen nihil horum delegerit sibi ad gloriam, sed ita pronuntiaverit: *Gloriam Dei esse, celare rem; gloriam regis, investigare rem*[77].

Rursus (si placet) reputet quispiam, quantum intersit inter hominum vitam in excultissima quapiam Europæ provincia, et in regione aliqua novæ Indiæ maxime fera et barbara: eas tantum differre existimabit, ut merito *hominem homini Deum esse*[78], non solum propter auxilium et beneficium, sed etiam per status comparationem, recte dici possit. Atque hoc non solum, non cœlum, non corpora, sed artes præstant.

Rursus, vim et virtutem et consequentias rerum inventarum notare juvat; quæ non in aliis manifestius occurrunt, quam in illis tribus, quæ antiquis incognitæ, et quarum primordia, licet recentia, obscura et ingloria sunt: artis nimirum imprimendi, pulveris tormentarii, et acus nauticæ. Hæc enim tria, rerum faciem et statum in orbe terrarum mutaverunt: primum, in re literaria; secundum, in re bellica; tertium, in navigationibus; unde innumeræ rerum mutationes sequutæ sunt; ut non imperium aliquod, non secta, non stella

76 Lucret. vi. 1. In the original it is "Primæ" for "Primum," and "præclaro" for "præstanti."

77 Prov. xxv. 2.

78 "Homo homini Deus, si suum officium sciat." An Aphorism of Cæcilius Comicus apud Symmach. Epist. x. 104. (al. 114.) Bacon has expanded the meaning of the saying (according to his wont) beyond its original extent. See Zenobius, Cent. i. 91. in Gaisford's Parœmiographi Græci, where the proverb is *Ἄνθρωπος ἀνθρώπου δαιμόνιον.*

majorem efficaciam et quasi influxum super res humanas exercuisse videatur, quam ista mechanica exercuerunt.

Præterea non abs re fuerit, tria hominum ambitionis genera et quasi gradus distinguere. Primum eorum, qui propriam potentiam in patria sua amplificare cupiunt; quod genus vulgare est et degener. Secundum eorum, qui patriæ potentiam et imperium inter humanum genus amplificare nituntur: illud plus certe habet dignitatis, cupiditatis haud minus. Quod si quis humani generis ipsius potentiam et imperium in rerum universitatem instaurare et amplificare conetur; ea proculdubio ambitio (si modo ita vocanda sit[79]) reliquis et sanior est et augustior. Hominis autem imperium in res in solis artibus et scientiis ponitur: naturæ enim non imperatur, nisi parendo[80].

Præterea, si unius alicujus particularis inventi utilitas ita homines affecerit, ut eum, qui genus humanum universum beneficio aliquo devincire potuerit, homine majorem putaverint; quanto celsius videbitur, tale aliquid invenire, per quod alia omnia expedite inveniri possint? Et tamen (ut verum omnino dicamus) quemadmodum luci magnam habemus gratiam, quod per eam vias inire, artes exercere, legere, nos invicem dignoscere possimus, et nihilominus ipsa visio lucis res præstantior est et pulchrior, quam multiplex ejus usus: ita certe ipsa contemplatio rerum, prout sunt, sine superstitione aut impostura, errore aut confusione, in

79 Bacon is perhaps right in doubting whether Ambition can fairly be stretched so as to include this third head. Surely its object must be in reality "power for oneself."

80 Cf. supr. I. 3. This is an allusion to the description of the qualities of a good general. Livy, xxi. 4. "ingenium idem ad res diversissimas, *parendum* atque *imperandum*." "He only conquers who has learnt how to obey."

se ipsa magis digna est, quam universus inventorum fructus.

Postremo, siquis depravationem scientiarum et artium ad malitiam et luxuriam, et similia, objecerit; id neminem moveat[81]. Illud enim de omnibus mundanis bonis dici potest, ingenio, fortitudine, viribus, forma, divitiis, luce ipsa, et reliquis. Recuperet modo genus humanum jus suum in naturam, quod ei ex dotatione divina competit; et detur ei copia: usum vero recta ratio et sana religio gubernabit.

CXXX.

Jam vero tempus est, ut artem ipsam *interpretandi* naturam proponamus: in qua licet nos utilissima et verissima præcepisse arbitremur, tamen necessitatem ei absolutam (ac si absque ea nil agi possit) aut etiam perfectionem non attribuimus. Etenim in ea opinione sumus; si justam naturæ et experientiæ historiam præsto haberent homines, atque in ea sedulo versarentur; sibique duas res imperare possent; unam, ut receptas opiniones et notiones deponerent; alteram, ut mentem a generalissimis et proximis ab illis ad tempus cohiberent; fore ut etiam vi propria et genuina mentis, absque alia arte, in formam nostram *interpretandi* incidere possent. Est enim *interpretatio* verum et naturale opus mentis, demptis iis, quæ obstant: sed tamen omnia certe per nostra præcepta erunt magis in procinctu, et multo firmiora.

Neque tamen illis nihil addi posse affirmamus: sed contra, nos, qui mentem respicimus, non tantum in facultate propria, sed quatenus copulatur cum rebus, ar-

[81] This is the ordinary topic of all cavillers. As Aristotle has noticed of it, Eth. Nic. I. iii. 3. Τοιαύτην δέ τινα πλάνην ἔχει καὶ τἀγαθὰ διὰ τὸ πολλοῖς συμβαίνειν βλάβας ἀπ᾽ αὐτῶν· ἤδη γάρ τινες ἀπώλοντο διὰ πλοῦτον, ἕτεροι δὲ δι᾽ ἀνδρείαν.

tem inveniendi cum inventis adolescere posse, statuere debemus[82].

[82] This passage has been wrongly given in translations. It simply means that "*we*, who regard the connection between the Mind and things, ought to allow the possibility, nay, more, the probability, that as Knowledge grows, the Method of obtaining Knowledge will grow also." Cf. supr. I. 104. and Adv. of Learning, p. 189. (where he is speaking of Topics. "In these it holdeth, Ars inveniendi adolescit cum Inventis; &c." D. Stewart, Philosophy of the Human Mind, Introd. II. § 2, quotes this passage, while speaking of the experience of each person being put into system: such method (i. e.) of science, that each successive generation may profit by its predecessors, and advance steadily. This is now done in some subjects; such (e. g.) as Mathematics, in which beginners now almost outstrip the whole knowledge of men a century ago.

LIBER SECUNDUS

APHORISMORUM[1]

DE

INTERPRETATIONE NATURÆ,

SIVE

DE REGNO HOMINIS.

APHORISMUS I[2].

SUPER datum corpus novam naturam, sive novas naturas generare et superinducere, opus et intentio est

[1] If the "Aphorisms" of the first Book were by no means "breves eædemque sparsæ, nec methodo revinctæ sententiæ," (I. 86), still less are they such here: for in this Book they are long chapters.

[2] These Aphorisms are very obscure, and it is doubtful how far their main object, the discovery of Forms, is practicable. Bacon's language is not free from the technicalities of the Schools, nor are his thoughts at all clear; nor do his illustrations carry us far towards the end he puts before himself. With all this, no one ought to underrate the value of these Chapters; for they are full of most useful matter: and Bacon's accounts of Latent Process and Structure are excellent. The Morning Star, though it belongs "better to the dawn," is yet "last in the train of Night;" and we must expect obscurities.

Even those who have not the patience to read through the twenty-seven "Prerogatives among Instances," ought to endeavour to make themselves masters of these first twenty Aphorisms; for they were intended by Bacon to illustrate and expand the statements made at the opening of the work, (Bk. I. 1—3, &c.), and are clearly meant to give us a concise view (with an example) of the End and Method, for which he has been preparing us throughout Bk. I. And no one who cares to understand Bacon's objects and system can omit them. As to the objections that the end is quite unattainable, and that the Method

humanæ potentiæ[3]. Datæ autem naturæ formam, sive differentiam veram, sive naturam naturantem, sive fontem emanationis (ista enim vocabula habemus, quæ ad indicationem rei proxime accedunt) invenire, opus et intentio est humanæ scientiæ[4]. Atque his operibus primariis subordinantur alia opera duo secundaria et inferioris notæ; priori, transformatio corporum concretorum de alio in aliud, intra terminos *possibiles;* posteriori, inventio, in omni generatione et motu, *latentis processus*[5] continuati ab efficiente manifesto, et materia manifesta, usque ad formam inditam; et inventio similiter *latentis schematismi*[6] corporum quiescentium, et non in motu.

is obsolete—for the first, it is enough to say that if the end is unattainable, still it was a noble theory of "Knowledge and Power," and that the means which he explains are constantly used to this day for the discovery of new Truths. And the Method, even if it were obsolete (which is not really the case), is the basis of all modern Method of Induction: and no Physical student ought to ignore the bold and clear statements which roused men to think for themselves on this matter, and led to the glorious developments of the genius of Newton and of Modern Chemistry. As to the objection against Bacon's credulity and error in his Physical statements and questions, it is enough to quote as his apology the remarks of Seneca; Veniet tempus, quo ista quæ nunc latent in lucem dies extrahat, et longioris ævi diligentia: ad inquisitionem tantorum ætas una non sufficit. Veniet tempus, quo posteri nostri tam aperta nos nesciisse mirentur." Sen. Quæst. Nat. vii. 25.

[3] The extent of Human Power is limited only by the condition of its being exercised in conformity with the Laws of Nature, (Herschel's Discourse): but "the generation of New Natures" seems to point to more than this. What Bacon meant may be well illustrated by reference to his New Atlantis, where "the Brethren of Solomon's House" are engaged upon the search after such New Natures. I suppose the making of Bread would be a homely case, or of Gunpowder, or of many chemical and medicinal combinations. And the principle of Human Power seems to be the application of the Powers of Nature to the uses of Man. We must recollect that many of our most mighty discoveries of Power are not discoveries of New Natures, but applications; as the uses of Steam, or the discovery of the Electric Telegraph.

[4] The end of Human Knowledge, the "Discovery of Forms," is best discussed separately. See Aph. E.

[5] For Latent Process, see infr. II. 6.

[6] For Latent Structure, see infr. II. 7.

II.

Quam infeliciter se habeat scientia humana, quæ in usu est, etiam ex illis liquet, quæ vulgo asseruntur. Recte ponitur; *Vere scire, esse per causas scire*[7]. Etiam

[7] *'Επίστασθαι οἰόμεθα ὅταν τήν τ' αἰτίαν οἰώμεθα γινώσκειν, δι' ἣν τὸ πρᾶγμά ἐστιν, ὅτι ἐκείνου αἰτία ἐστί.* Arist. Anal. Post. I. ii. These are the four Aristotelian *ἀρχαὶ*—(1) the Material, *ἡ ὕλη* or *τὸ ὑποκείμενον*. (2) The Formal, *τὸ τί ἦν εἶναι*: (3) The Efficient, *ἡ ἀρχὴ ὅθεν ἡ κίνησις*: (4) The Final, *τὸ οὗ ἕνεκα*. Cf. Ar. Metaph. II. 2. For what is really meant by "cause" and "effect," and for the ignorance of Man as to the real nature of Antecedents and of their connection with their Consequents, see D. Stewart's Philosophy of the Human Mind, chap. i. § 2, and note C on the same place.

Of these four causes, Bacon considers that three are legitimate objects for study and for discovery of Truth; the fourth he regards as harmful. By the *Material* cause is meant the Material Elements or particles of which a body is composed. Investigation into this will be that of the Chemists when they seek for simple substances. The *Formal* cause is the principle or power, whatever it is, which makes each thing that is generated in the world keep within its own limits—as, e. g. it would be the "Form" that obliges a grain of wheat to expand into the stalk and ear of Wheat, and not of Barley. By the *Efficient* cause we usually mean all the lower motive causes (the will of God and the Formal Causes being regarded as the higher motives)—thus the hand of the sower, the soil, the dews, &c. would be efficient Causes of the growth of the grain of wheat. And the *Final* Cause is the same with the end for which a thing exists. So multiplication of grain for the service and sustenance of man would be the final cause of Wheat. This last Cause is clearly subjective, and depends upon our conception of things, rather than on the nature of things themselves. It is in fact our notion of the Intentions of Nature "plane ex natura hominis, potius quam universi." (I. 48.) And it seems clear that in general the study of Final Causes would tend to damage our search after Truth. To know the actual nature of a thing, we must investigate it in and for itself, not for its results. For instance, we should never know the nature of Air, by contemplating the fact that it supports life. At the same time these Final Causes are facts in the constitution of Nature; and if fairly treated, may lead to much knowledge. And we find in the Adv. of Learning (p. 143—146) some very just observations on Final Causes, which throw great light on this condemnation of them. Bacon there attacks them solely when regarded as parts of *Physics*, and allows that they may well be inquired and collected in "*Metaphysique*;" and so, though he considered the Atheistical Philosophy of Democritus more sound for Physical investigation than the mixed Philosophies of Aristotle and Plato, yet he takes great care to acknowledge the truth and worth of Final Causes, and to protest against its being alleged (as it was doubtless then, and has been since,) that by reducing them to their proper position, he was "call-

non male constituuntur causæ quatuor; materia, forma, efficiens, et finis. At ex his causa finalis tantum abest ut prosit, ut etiam scientias corrumpat, nisi in hominis actionibus. Formæ inventio habetur pro desperata. Efficiens vero, et materia (quales quæruntur et recipiuntur, remotæ scilicet, absque *latenti processu* ad formam) res perfunctoriæ sunt, et superficiales, et nihili fere ad scientiam veram et activam. Neque tamen obliti sumus, nos superius[8] notasse et correxisse errorem mentis humanæ, in deferendo formis primas essentiæ. Licet enim in natura[9] nihil vere existat præter

ing in question or derogating from Divine Providence." He was rather "highly confirming and exalting it." To say that Final Causes will not teach us the actual constitution of things, cannot be regarded as in any sense an attack on the "Argument from Design," on which writers on "the Religion of Nature" base so much. Having thus vindicated Bacon from the grave charge of altogether ejecting Final Causes, and of favouring Atheism, it only remains to be seen whether he is right in condemning their connection with Physical Investigation. Here, I believe, the actual progress of Science would have led him to modify his judgment. "It must be allowed that apart from the charm which the Final Causes, or ends of things, lend to Nature, when they are satisfactorily perceived, (which is the moral use of them), there are some cases in which a consideration of them has conduced to actual discoveries in science." So in the famous case of Harvey's discovery of the circulation of the blood from the consideration of the Final Causes of the valves in the veins of the animal body. This modification of Bacon's view is connected, however, with that lower view of the end and aim of Physical Science, which we are led to take, in consequence of the actual progress of Knowledge, and of our abandoning the search after Form. We are content to affirm Οὐθὲν μάτην ποιεῖ ἡ φύσις—and to use Nature's desire of an end, as a means for the discovery of Truth—just as the Moral Philosophers may fairly do with Moral Truths. For discussion on this point, see Hallam's Lit. of Europe, part III. chap. iii. § 51. and D. Stewart's Phil. of the Human Mind, part II. ch. iv. vi. § 1. where the subject is very judiciously treated. And for the whole subject of the Knowledge of Causes, see D. Stewart, part II. ch. iv. § 1.

8 "Superius," i. e. I. 51, 65. Can the reading "formis primas essentiæ" be correct? Bacon refers to Platonic Ideas.

9 "In natura," i. e. in the world outside Man—the Material World. Otherwise what would become of thought, sensation, &c.? This is one of the passages which seem at first sight to favour the Materialist School. But it does not; for Bacon

corpora individua, edentia actus puros individuos ex lege; in doctrinis tamen, illa ipsa lex, ejusque inquisitio, et inventio, atque explicatio, pro fundamento est tam ad sciendum, quam ad operandum. Eam autem *legem*, ejusque *paragraphos*[10], formarum nomine intelligimus; præsertim cum hoc vocabulum invaluerit, et familiariter occurrat.

III.

Qui causam alicujus naturæ (veluti albedinis, aut caloris) in certis tantum subjectis novit; ejus scientia imperfecta est: et qui effectum super certas tantum materias (inter eas, quæ sunt susceptibiles) inducere potest; ejus potentia pariter imperfecta est[11]. At qui efficientem et materialem causam tantummodo novit, (quæ causæ fluxæ sunt, et nihil aliud, quam vehicula et causæ formam deferentes in aliquibus) is ad nova inventa, in materia aliquatenus simili, et præparata, pervenire potest; sed rerum terminos altius fixos non movet. At qui formas novit, is naturæ unitatem in materiis dissimillimis complectitur; itaque quæ adhuc facta non sunt, qualia nec naturæ vicissitudines, neque experimentales industriæ, neque casus ipse, in actum unquam perduxissent, neque cogitationem humanam subitura fuissent, detegere et producere potest. Quare ex formarum inventione sequitur contemplatio vera, et operatio libera[12].

evidently distinguishes between *Natura* and *Doctrina;* and under the latter head will come conception, thought, &c. Mill in his Categories takes the wider sense of the term Nature, and includes mental operations. (See Mill's Logic, Book I. chap. iii. § 15.)

10 It is difficult to see what is meant by the "Paragraphs" of a Law; especially if Law and Form be the same thing. Perhaps the description of the Form of Heat—the Modifications of the genus "Motion," may be what is meant. Cf. infr. II. 20.

11 This imperfect Knowledge and Power might be termed Empiric, as having no insight into the principle or Law.

12 This combination of Knowledge and Action is ever present to

IV.

Licet viæ ad potentiam, atque ad scientiam humanam, conjunctissimæ sint, et fere eædem; tamen propter perniciosam et inveteratam consuetudinem versandi in abstractis, tutius omnino est ordiri et excitare scientias ab iis fundamentis, quæ in ordine sunt ad partem activam, atque ut illa ipsa partem contemplativam signet et determinet[13]. Videndum itaque est ad aliquam naturam super corpus datum generandam et superinducendam, quale quis præceptum, aut qualem quis directionem, aut deductionem maxime optaret; idque sermone simplici, et minime abstruso.

Exempli gratia; si quis argento cupiat superinducere flavum colorem auri, aut augmentum ponderis, (servatis legibus materiæ) aut lapidi alicui non diaphano diaphaneitatem, aut vitro tenacitatem, aut corpori alicui non vegetabili vegetationem; videndum (inquam) est, quale quis præceptum, aut deductionem potissimum sibi dari exoptet. Atque primo, exoptabit aliquis proculdubio,

Bacon's mind, as his great end. Cf. I. 3. 81. II. 1. "One of the considerations," (says Playfair, Encycl. Brit. Dissert. iii. p. 454,) "which appear to have struck Bacon's mind most forcibly, was the vagueness and uncertainty of all the Physical speculations then existing, and the entire want of connection between the Sciences and the Arts. Though these two things are in their nature so closely allied, that the same Truth which is a principle in Science becomes a rule in Art; yet there was at that time hardly any practical improvement which had arisen from a theoretic discovery. The natural alliance between the Knowledge and the Power of man seemed entirely interrupted." For Bacon's own hopes for Knowledge under this combination, see infr. II. 31. Cf. also infr. II. 17. ad fin.

[13] This is in pity for man's feeble grasp of all but matters of action, and also in despair at man's love for baseless speculation. As meeting both difficulties he begins with precepts for Human Power, rather than with those for Knowledge; although the two are most nearly connected, and though it would be more in accordance with his plan to begin with the discovery of Form. He cannot, however, resist the temptation of sketching out part of his conception of Form. Cf. also infr. II. 13. 17. and Appendix E. Bacon's language throughout this Aphorism is thoroughly Scholastic.

sibi monstrari aliquid hujusmodi, quod opere non frustret, neque experimento fallat. Secundo, exoptabit quis aliquid sibi præscribi, quod ipsum non astringat et coerceat ad media quædam, et modos quosdam operandi particulares. Fortasse enim destituetur, nec habebit facultatem, et commoditatem, talia media comparandi et procurandi. Quod si sint et alia media, et alii modi (præter illud præceptum) progignendæ talis naturæ; ea fortasse ex iis erunt, quæ sunt in operantis potestate; a quibus nihilominus per angustias præcepti excludetur, nec fructum capiet. Tertio, optabit aliquid sibi monstrari, quod non sit æque difficile ac illa ipsa operatio de qua inquiritur, sed propius accedat ad praxin.

Itaque de præcepto vero et perfecto operandi pronuntiatum erit tale; *Ut sit certum, liberum, et disponens, sive in ordine ad actionem.* Atque hoc ipsum idem est cum inventione formæ veræ. Etenim forma naturæ alicujus talis est, ut, ea posita, natura data infallibiliter sequatur. Itaque adest perpetuo, quando natura illa adest, atque eam universaliter affirmat, atque inest omni. Eadem forma talis est, ut, ea amota, natura data infallibiliter fugiat. Itaque abest perpetuo, quando natura illa abest, eamque perpetuo abnegat, atque inest soli. Postremo, forma vera talis est, ut naturam datam ex fonte aliquo essentiæ deducat, quæ inest pluribus, et notior est naturæ (ut loquuntur) quam ipsa forma. Itaque de axiomate vero et perfecto sciendi pronuntiatum et præceptum tale est; *ut inveniatur natura alia, quæ sit cum natura data convertibilis, et tamen sit limitatio naturæ notioris, instar generis veri.* Ista autem duo pronuntiata, activum et contemplativum, res eadem sunt; et quod in operando utilissimum, id in sciendo verissimum.

V.

At præceptum sive axioma de transformatione corporum duplicis est generis. Primum[14] intuetur corpus, ut turmam sive conjugationem naturarum simplicium, ut in auro hæc conveniunt; quod sit flavum; quod sit ponderosum, ad pondus tale; quod sit malleabile, aut ductile, ad extensionem talem; quod non fiat volatile, nec deperdat de quanto suo per ignem; quod fluat fluore tali; quod separetur et solvatur modis talibus: et similiter de ceteris naturis, quæ in auro concurrunt. Itaque hujusmodi axioma rem deducit ex formis naturarum simplicium. Nam qui formas et modos novit superinducendi flavi, ponderis, ductilis, fixi, fluoris, solutionum, et sic de reliquis, et eorum gradationes et modos; videbit et curabit, ut ista conjungi possint in aliquo corpore, unde sequatur transformatio in aurum. Atque hoc genus operandi pertinet ad actionem primariam. Eadem enim est ratio generandi naturam unam aliquam simplicem, et plures; nisi quod arctetur magis et restringatur homo in operando, si plures requirantur, propter difficultatem tot naturas coadunandi; quæ non facile conveniunt, nisi per vias naturæ tritas et ordinarias. Utcunque tamen dicendum est, quod iste modus operandi (qui naturas intuetur simplices, licet in corpore concreto) procedat ex iis, quæ in natura sunt constantia, et æterna, et catholica, et latas præbeat potentiæ humanæ vias, quales (ut nunc sunt res) cogitatio humana vix capere aut repræsentare possit.

[14] Bacon hardly means here simple *elements*, but simple *qualities*; so that it does not refer to the Analyses of Chemistry. He seems to think that a knowledge of these simple qualities, if added to a knowledge of Forms, will enable him to produce particular Natures; and these would be either (1) the reproduction of known things, as, e. g., when we obtain Water by combining Oxygen and Hydrogen; or (2) the obtaining new combinations by synthesis, as when men made Bell-metal.

At secundum genus axiomatis[15] (quod a *latentis processus* inventione pendet) non per naturas simplices procedit, sed per concreta corpora, quemadmodum in natura inveniuntur, cursu ordinario. Exempli gratia; in casu ubi fit inquisitio, ex quibus initiis, et quo modo, et quo processu, aurum, aut aliud quodvis metallum, aut lapis generetur, a primis menstruis, aut rudimentis suis, usque ad mineram perfectam: aut similiter, quo processu herbæ generentur, a primis concretionibus succorum in terra, aut a seminibus, usque ad plantam formatam, cum universa illa successione motus, et diversis et continuatis naturæ nixibus; similiter, de generatione ordinatim explicata animalium, ab initu ad partum; et similiter de corporibus aliis.

Enimvero neque ad generationes corporum tantum spectat hæc inquisitio, sed etiam ad alios motus et opificia naturæ. Exempli gratia; in casu ubi fit inquisitio de universa serie et continuatis actionibus alimentandi, a prima receptione alimenti ad assimilationem perfectam; aut similiter de motu voluntario in animalibus, a prima impressione imaginationis, et continuatis nixibus spiritus, usque ad flexiones et motus artuum; aut de explicato motu linguæ, et labiorum, et instrumentorum reliquorum, usque ad editionem vocum articulatarum. Nam hæc quoque spectant ad naturas concretas, sive collegiatas, et in fabrica; et intuentur veluti consuetudines naturæ

[15] The second kind of Transformation (stripping it of useless and strange language) is simply an investigation into divers processes of growth — registration of facts of progress. Not, however, identical with Latent Process (as Bacon explains), because it has nothing to do with the discovery of Form. It concerns itself solely with concrete bodies, as they are found in Nature. This part of Physical investigation, obscurely as it is here stated, has proved the basis of much modern Medical knowledge and skill, as may be seen from Haller's Physiology. Though Bacon here again shews that he hopes too much, and has set man's Power too high; still we cannot but admire his grasp of things, and his prophetic glance.

particulares et speciales, non leges fundamentales et communes, quæ constituunt formas. Veruntamen omnino fatendum est, rationem istam videri expeditiorem, et magis sitam in propinquo; et spem injicere magis, quam illam primariam.

At pars operativa similiter, quæ huic parti contemplativæ respondet, operationem extendit et promovet ab iis, quæ ordinario in natura inveniuntur, ad quædam proxima[16], aut a proximis non admodum remota; sed altiores et radicales operationes super naturam pendent utique ab axiomatibus primariis. Quinetiam ubi non datur homini facultas operandi, sed tantum sciendi, ut in cœlestibus, (neque enim conceditur homini operari in cœlestia, aut ea immutare aut transformare) tamen inquisitio facti ipsius, sive veritatis rei, non minus quam cognitio causarum et consensuum, ad primaria illa et catholica axiomata de naturis simplicibus (veluti de natura rotationis spontaneæ[17], attractionis sive virtutis magneticæ, et aliorum complurium, quæ magis communia sunt, quam ipsa cœlestia) refertur. Neque

[16] This generation of "quædam proxima," of new natures near akin to those we already have got, by careful imitation of the processes of Nature, is not an impossibility.

[17] One is tempted to put down Bacon's attachment to this doctrine of Spontaneous Rotation, and his declaration that the question as to the centre of the system of which the earth is a member cannot be solved, till Spontaneous Rotation is fully understood, as a specimen of his own subjection to one of those "Idola Theatri," against which he had inveighed so justly and so eloquently in the first Book. Bacon definitely condemns the Copernican system in the Fourth Book of the De Augm. Scient.: as also is the case in II. 36, where he discusses more at length the nature of Spontaneous Rotation. (Cf. also infr. II. 48. motus 17.) We must still, in fairness, recollect, however absurd his views may seem to us on this point, they were almost universally received in his days; and that, on the contrary, the Copernican system was as yet a mere Hypothesis, supported by no recommendations, except that of its simplicity—the law and principle of the thing, which settled the question for ever, were not revealed till Newton had discovered the Law of Gravity.

enim speret aliquis terminare quæstionem, utrum in motu diurno revera terra aut cœlum rotet; nisi naturam rotationis spontaneæ prius comprehenderit.

VI.

Latens autem *processus*[18], de quo loquimur, longe alia res est, quam animis hominum (qualiter nunc obsidentur) facile possit concurrere. Neque enim intelligimus mensuras quasdam, aut signa, aut scalas processus, in corporibus spectabiles; sed plane processum continuatum, qui maxima ex parte sensum fugit.

Exempli gratia; in omni generatione et transformatione corporum inquirendum, quid deperdatur et evolet, quid maneat, quid accedat; quid dilatetur, quid contrahatur; quid uniatur, quid separetur; quid continuetur, quid abscindatur; quid impellat, quid impediat; quid dominetur, quid succumbat; et alia complura.

Neque hic rursus hæc tantum in generatione aut transformatione corporum quærenda sunt; sed et in

18 "Latent Process is the secret and invisible process by which sensible changes are brought about, and seems, in Bacon's acceptation, to involve the principle since called the Law of Continuity, according to which no change, however small, can be effected but in *time*. To know the relation between the time and the change effected in it, would be to have a perfect knowledge of the Latent Process." Playfair's Encycl. Brit. vol. I. Dissert. iii. p. 459. In Bacon's account of the Process of Nature, we see the germ of the Calculus, in which he evidently would have rejoiced. See Price on the Infinitesimal Calculus, vol. I. part. II. chap. ix. (Cf. also infr. II. 8 ad fin.) Bacon's hopes of reaching things not perceptible to the senses under ordinary circumstances, have been realised theoretically by the grand principles of the Calculus, and practically to a great extent by the discovery of the Microscope. The "per minima, aut saltem per illa, quæ sunt minora quam ut sensum feriant" of this Aphorism, is language quite fit for the Calculus. This remark holds, too, of Latent Structure. But by all we discover, we only learn the deep truth of Bacon's Aphorism (I. 10): "Subtilitas Naturæ subtilitatem sensus multis partibus superat." Nor can life and extension of knowledge teach man any other lesson.

omnibus aliis alterationibus et motibus similiter inquirendum, quid antecedat, quid succedat; quid sit incitatius, quid remissius: quid motum præbeat, quid regat; et hujusmodi. Ista vero omnia scientiis (quæ nunc pinguissima Minerva, et prorsus inhabili, contexuntur) incognita sunt et intacta. Cum enim omnis actio naturalis per minima transigatur, aut saltem per illa, quæ sunt minora, quam ut sensum feriant; nemo se naturam regere aut vertere posse speret, nisi illa debito modo comprehenderit et notaverit.

VII.

Similiter, inquisitio et inventio *latentis schematismi*[19] in corporibus res nova est; non minus quam inventio

[19] "The Latent Structure is that invisible structure of bodies, on which so many of their properties depend." A good illustration of this process of investigation is to be found in Crystallography, or in microscopic treatment of substances like the Blood, stalks of herbs, &c. One would hardly agree, however, with Bacon in regarding Distillation as a part of this Investigation; it would rather seem to belong to Chemistry, whose objects, Herschel lays it down (Disc. on Nat. Phil. § 332) are, "the Laws which concern the intimate constitution of bodies, not as respects their *Structure* or the manner in which their parts are put together, but as regards the *materials* or ingredients of which those parts are composed." In this part of physical study also Bacon seems to have hoped for far more than we can hope to attain to. In the example given below his language is most scholastic:—"spiritus," "essentia tangibilis," &c. and he seems to believe that there is a hope of our reaching a solution of the problem of Life by means of the study of Structure. Perhaps Mr. Mill's illustrations of his Method of Agreement and Difference will give us a good instance of what Bacon means by the discovery, and application of our knowledge, of *Latent Structure*. (Logic; III. chap. viii. § 1.) where he refers to the production of Quartz Crystals by keeping a phial filled with water charged with siliceous particles undisturbed for several years: and better still would be his illustration of Sir James Hall's production of artificial marble, by the cooling of its materials from fusion under immense pressure. These would be applications of *Latent Process* to the *Latent Structure*. For we must first have analysed the components, &c. of quartz crystal, or marble, and then have applied that knowledge, together with an imitation of the *Process* of Nature, to the creating of the *Latent Structure*. The operations are not unlike some of those sketched out in the New Atlantis.

latentis processus et formæ. Versamur enim plane adhuc in atriis naturæ, neque ad interiora paramus aditum. At nemo corpus datum nova natura dotare, vel in novum corpus feliciter et apposite transmutare potest, nisi corporis alterandi aut transformandi bonam habuerit notitiam. In modos enim vanos incurret, aut saltem difficiles et perversos, nec pro corporis natura, in quod operatur. Itaque ad hoc etiam via plane est aperienda et munienda.

Atque in anatomia corporum organicorum (qualia sunt hominis, et animalium) opera sane recte et utiliter insumitur, et videtur res subtilis, et scrutinium naturæ bonum. At hoc genus anatomiæ spectabile est, et sensui subjectum, et in corporibus tantum organicis locum habet. Verum hoc ipsum obvium quiddam est, et in promptu situm, præ anatomia vera *schematismi latentis* in corporibus, quæ habentur pro similaribus; præsertim in rebus specificatis, et earum partibus, ut ferri, lapidis; et partibus similaribus plantæ, animalis, veluti radicis, folii, floris, carnis, sanguinis, ossis, &c. At etiam in hoc genere non prorsus cessavit industria humana; hoc ipsum enim innuit separatio corporum similarium per distillationes, et alios solutionum modos, ut dissimilaritas compositi per congregationem partium homogenearum appareat. Quod etiam ex usu est, et facit ad id quod quærimus; licet sæpius res fallax sit; quia complures naturæ separationi imputantur et attribuuntur, ac si prius substitissent in composito; quas revera ignis et calor, et alii modi apertionum de novo indunt, et superinducunt [20]. Sed et hæc quoque parva

[20] Of the application of Fire enough cannot be said in praise. It has done more to aid the discoveries of chemistry, and to better the arts of life, than any other means. The ancient fable of Prometheus comes into our mind. A good instance of this "de novo indunt et

pars est operis, ad inveniendum *schematismum* verum in composito; qui *schematismus* res est longe subtilior, et accuratior, et ab operibus ignis potius confunditur quam eruitur et elucescit.

Itaque facienda est corporum separatio et solutio; non per ignem certe, sed per rationem et *inductionem* veram, cum experimentis auxiliaribus; et per comparationem ad alia corpora, et reductionem ad naturas simplices, et earum formas, quæ in composito conveniunt et complicantur; et transeundum plane a Vulcano ad Minervam, si in animo sit veras corporum texturas et *schematismos* (unde omnis occulta atque (ut vocant) specifica proprietas et virtus in rebus pendet, unde etiam omnis potentis alterationis et transformationis norma educitur) in lucem protrahere.

Exempli gratia; inquirendum, quid sit in omni corpore spiritus, quid essentiæ tangibilis; atque ille ipse spiritus, utrum sit copiosus et turgeat, an jejunus et paucus; tenuis, aut crassior; magis aëreus, aut igneus; acris, aut deses; exilis, aut robustus; in progressu, aut in regressu; abscissus, aut continuatus; consentiens cum externis et ambientibus, aut dissentiens; &c. Et similiter, essentia tangibilis, (quæ non pauciores recipit differentias, quam spiritus) atque ejus villi, et fibræ, et omnimoda textura. Rursus autem collocatio spiritus per corpoream molem, ejusque pori, meatus, venæ, et cellulæ, et rudimenta, sive tentamenta corporis organici, sub eandem inquisitionem cadunt. Sed et in his

superinducunt" would be the belief in the imaginary substance "Phlogiston," which was supposed to be absolutely light, and to pass off from Iron, when fused; whereas in reality the increase of weight to the Iron arises from the absorption of Oxygen from the air. So although there is ground for caution, yet Bacon's condemnation of the use of Fire and Heat is wrong. They are instruments for experiment of the highest value: though, like all instruments, they have their faults, and require careful correction.

quoque, atque adeo in omni *latentis schematismi* inventione, lux vera et clara ab axiomatibus primariis immittitur, quæ certe caliginem omnem et subtilitatem discutit.

VIII.

Neque propterea res deducetur ad atomum[21], quæ præsupponit vacuum, et materiam non fluxam, (quorum utrumque falsum est) sed ad particulas veras, quales inveniuntur. Neque rursus est, quod exhorreat quispiam istam subtilitatem, ut inexplicabilem; sed contra, quo magis vergit inquisitio ad naturas simplices, eo magis omnia erunt sita in plano et perspicuo; translato negotio a multiplici in simplex; et ab incommensurabili ad commensurabile; et a surdo ad computabile; et ab infinito et vago ad definitum et certum; ut fit in elementis literarum, et tonis concentuum. Optime autem cedit inquisitio naturalis, quando physicum terminatur in mathematico[22]. At rursus multitudi-

[21] A distinction must be drawn between the Epicurean similar Atoms, and the "Particles" of which all natural bodies are composed. See Herschel's Discourse on Nat. Phil. § 339—343.

The Epicurean Atom was an almost abstract conception, and was not based on far-extended physical knowledge, as is the "Atomic Theory" of Dalton. See Encycl. Metr. Article Chemistry, § 116. See the subject historically and philosophically discussed in Dr. Daubeny's "Introduction to the Atomic Theory."

As to the *Vacuum* which Bacon supposed impossible, see his statements, supr. I. 66. (ad fin.) By "Materia non fluxa," he doubtless refers to the dogma of the "Eternity of Matter," a part of the Atheistic System of Cosmogony.

[22] Of the exact meaning of this paragraph there is some doubt. One rendering is, "when a Physical Discovery is converted into a Mathematical Theorem:" as (I suppose it is meant) when Kepler's Laws were Mathematically stated. Perhaps the illustration of Optics, in which certainty is quite obtained by substitution of certain formulæ for Physical facts (after due investigation of Instances), will throw light upon the case. Or the Mathematical investigation of Central Forces, based on Physical experience, and embracing both results not known in Nature, and the simplest expression of all the Laws which Physical Phenomena follow, would be a case in point. Cf. supr. I. 96.

nem aut fractiones nemo reformidet. In rebus enim, quæ per numeros transiguntur, tam facile quis posuerit aut cogitaverit millenarium, quam unum; aut millesimam partem unius, quam unum integrum.

IX.

Ex duobus generibus axiomatum, quæ superius posita sunt, oritur vera divisio philosophiæ, et scientiarum; translatis vocabulis receptis (quæ ad indicationem rei proxime accedunt) ad sensum nostrum. Videlicet, ut inquisitio *formarum*, quæ sunt (ratione certe, et sua lege) æternæ et immobiles, constituat *metaphysicam*[23]; inquisitio vero *efficientis*, et *materiæ*, et *latentis processus*, et *latentis schematismi*, (quæ omnia cursum naturæ communem et ordinarium, non leges fundamentales et

[23] Cf. De Augm. Scient. III. ch. iv.—vi. Adv. of Learning, p. 135—142. There he includes the investigation of Final Causes under Metaphysics. Here he abandons these, and seems to limit it to the discovery of Form. This is, as he says, "using the word *Metaphysique* in a different sense from that that is received." (For Bacon prefers, "perpurgato nomine," to retain old terms with new meanings, before coining new Terms as Aristotle did. It is a choice of evils: but modern science inclines to the use of new nomenclatures.) He places his *Metaphysique* next the Vertical point of knowledge—i. e. next the "Opus quod operatur deus a principio usque ad finem"—*the summary law of* Nature, as to which he doubts whether man can ever attain to it. Modern Philosophy has not ratified Bacon's use of the Term; for it has ruled the discovery of "causæ causantes" to be impossible; and so considers his *Metaphysique* as useless. The word, however, is still in constant use. The Ancients meant by it the contemplation of the absolute unchangeable causes of things (*τοῦ ὄντος, ᾗ ὄν*.) Modern writers use it somewhat vaguely. Perhaps in its widest usage it may even include Mathematics, as well as its more proper subjects, viz. speculations as to Time and Space, entity and non-entity, &c. and all the phenomena of Psychology. In this broad sense the Term will, in fact, include all truths except those immediately dependent on the senses, those taught us by God's Revelation, and those handed down by historic record. But, ordinarily, Mathematics are marked off, because of their vast and distinct importance.

Physics will be the investigation of all truths of sensible appreciation, with a view to the discovery of their general Laws. So Newton's Principia would be physical: and so would the Mixed Mathematics generally be. Cf. Mill's Logic, I. viii.

æternas respiciunt) constituat *physicam;* atque his subordinentur similiter practicæ duæ; *physicæ mechanica; metaphysicæ* (perpurgato nomine) *magia*[24], propter latas ejus vias, et majus imperium in naturam.

X.

Posito itaque doctrinæ scopo, pergendum ad præcepta; idque ordine minime perverso, aut perturbato. Atque indicia de *interpretatione naturæ* complectuntur partes in genere duas[25]; primam, de educendis aut excitandis axiomatibus ab experientia; secundam, de deducendis aut derivandis experimentis novis ab axiomatibus. Prior autem trifariam dividitur; in tres

24 The Μαγεία which Bacon thus wished to retain has vanished with the discussion of Forms; and we hear of no kind of Magic in Modern Philosophy. For Bacon's meaning cf. Adv. of Learning, p. 149, 150, where he notes it as deficient, and characterises it as "that great liberty and latitude of operation which dependeth upon the knowledge of *forms.*" He believed that as soon as men had discovered the Forms of things, they would be able to apply that knowledge to the most marvellous effect: and to produce results infinitely farther beyond the ordinary expectations of men, than even the tricks of the Magicians of his day were. Cf. also the Magical Instances, infr. II. 51.

25 Bacon's critics often forget this division of "Method" into the Inductive, and the Deductive. He never carried out the latter, leaving it as a duty to be performed by posterity. The charges against his Method which seem to be substantiated are those to which Coleridge (The Friend, vol. III. Essay 9) refers—the want of sufficient prominence given to the Mental Initiative, and (connected with it) the neglect of the fact, that the genius of man acting inductively may and does overleap the steps of Method; and arrives honestly at some great truth by a short road, as was the case with Dalton's Atomic Theory, and with the discoveries of a great part of Mixed Mathematics.

For the Deductive side of Method (in its modern sense), and its great value, see Mill's Logic, Bk. III. chap. xiii. § 7. "Deduction," he says, "is the great scientific work of the present and of future ages." And again, "A Revolution is peaceably and progressively effecting itself in Philosophy, the reverse of that to which Bacon has attached his name. That great man changed the Method of the Sciences from Deductive to Experimental, and it is now rapidly reverting from Experimental to Deductive." This is partly true, and Bacon seems to have expected it: but Mill's love for Deduction has led him to a narrowing of the field of Science. There is still scope for countless Inductions. Cf. Whewell on Induction, p. 75.

nempe ministrationes; ministrationem ad sensum; ministrationem ad memoriam; et ministrationem ad mentem, sive rationem.

Primo enim paranda est *historia naturalis* et *experimentalis*, sufficiens et bona; quod fundamentum rei est: neque enim fingendum, aut excogitandum, sed inveniendum, quid natura faciat, aut ferat[26].

Historia vero *naturalis* et *experimentalis* tam varia est et sparsa, ut intellectum confundat et disgreget, nisi sistatur et compareat ordine idoneo. Itaque formandæ sunt *tabulæ*[27], et *co-ordinationes instantiarum*, tali modo et instructione, ut in eas agere possit intellectus.

Id quoque licet fiat, tamen intellectus sibi permissus, et sponte movens, incompetens est et inhabilis ad opificium axiomatum, nisi regatur et muniatur. Itaque tertio, adhibenda est *inductio* legitima et vera, quæ ipsa *clavis* est *interpretationis*. Incipiendum autem est a fine, et retro pergendum ad reliqua.

XI.

Inquisitio formarum sic procedit[28]; super naturam

[26] This desire for a *Historia Naturalis* is probably the cause of his attaching a *Parasceue* as a kind of specimen to his first Edition. (London, 1620.)

[27] Of a first sketch of *Tables*, we had an example in the Sylva Sylvarum, "a Natural History in ten centuries"—a work without order or digestion, and not really fit to be called "Tables," for Bacon intended by it to "represent a knowledge broken," so to "invite men to inquire farther." See Rawley's Preface to the Sylv. Sylv. "I have heard his lordship say that one great reason why he would not put these particulars into any exact method (though he that looketh attentively into them shall find that they have a secret order) was, because he conceived that other men would now think that they could do the like, and so go on with a farther collection; which, if the Method had been exact, many would have despaired to attain by imitation." Perhaps the brief Table in the next Aphorism is a fairer specimen, though even there the instances follow no order; still they are connected with one definite subject.

[28] From Aph. 11–20 we have a particular illustration of the method

datam primo facienda est *comparentia*[29] *ad intellectum* omnium *instantiarum* notarum, quæ in eadem natura conveniunt, per materias licet dissimillimas. Atque hujusmodi collectio facienda est historice, absque contemplatione præfestina, aut subtilitate aliqua majore. Exempli gratia; in inquisitione de forma calidi.

Instantiæ convenientes in natura calidi.

1. Radii solis, præsertim æstate et meridie.
2. Radii solis reflexi et constipati, ut inter montes, aut per parietes, et maxime omnium in speculis comburentibus.
3. Meteora ignita.
4. Fulmina comburentia.
5. Eructationes flammarum ex cavis montium, &c.
6. Flamma omnis.
7. Ignita solida.
8. Balnea calida naturalia.

of Discovery of Forms—using the example of Heat. It is a striking part of the work; it shews how much Bacon could make of his materials. Many of his instances are wrong, but many are painstaking and judicious; and, though his "Vindemiatio Prima" is anything but a *Form* (as he defines it), and Bacon seems aware of this, in adding the adjective *Prima*, still it is to this day one of the theories as to the Nature of Heat. The 27 Instances in this Aphorism are in no order—"Collectio facienda historice;"—some are only subdivisions of others (as, e. g. 5 and 6, 8, 9 and 14, &c.); and Bacon was ignorant of two sources of Heat given by Herschel, as the most violent of all (Discourse on Nat. Phil. § 348), viz. (1) Combustion of Oxygen and Hydrogen in the exact proportion required for the production of Water; and (2) the discharge of a copious and continued current of Electricity through a small conductor. The "Absque contemplatione præfestina" is in strict accord with his Method, but looks very like the entire refusal of Coleridge's "Mental Initiative." The question suggests itself, what right have we to assume even so much knowledge of Heat as to be able to gather all these Instances? I suppose Nature answers this difficulty for Bacon, roughly; and the progress of knowledge enables us to correct errors, &c. For a good modern discussion of Heat, see Herschel's Discourse, chap. V. (§ 344–362.)

[29] *Comparentia*—a presentation in company—an arranged gathering.

9. Liquida ferventia, aut calefacta.
10. Vapores et fumi ferventes, atque aër ipse, qui fortissimum et furentem suscipit calorem, si concludatur; ut in reverberatoriis[30].
11. Tempestates aliquæ sudæ per ipsam constitutionem aëris, non habita ratione temporis anni.
12. Aër conclusus et subterraneus in cavernis nonnullis, præsertim hyeme.
13. Omnia villosa, ut lana, pelles animalium, et plumagines, habent nonnihil teporis.
14. Corpora omnia, tam solida, quam liquida, et tam densa, quam tenuia, (qualis est ipse aër) igni ad tempus approximata.
15. Scintillæ ex silice et chalybe per fortem percussionem.
16. Omne corpus fortiter attritum, ut lapis, lignum, pannus, &c. adeo ut temones, et axes rotarum, aliquando flammam concipiant; et mos excitandi ignis apud Indos occidentales fuerit per attritionem.
17. Herbæ virides et humidæ simul conclusæ et contrusæ, ut rosæ, pisæ in corbibus; adeo ut fœnum, si repositum fuerit madidum, sæpe concipiat flammam.
18. Calx viva, aqua aspersa.
19. Ferrum, cum primo dissolvitur per aquas fortes in vitro, idque absque ulla admotione ad ignem: et stannum similiter, &c. sed non adeo intense.
20. Animalia, præsertim et perpetuo per interiora;

[30] Reverberatories are furnaces constructed with two chambers; an outer one, which has no chimney, but has a passage connecting it with an inner one which has a chimney. The substance to be exposed to the heat is placed on the floor of the inner chamber, and fire is lighted in the other: so that the flame, having no outlet in the outer chamber, passes into the inner, over the substance, and is so concentrated with vast power upon it.

licet in insectis calor ob parvitatem corporis non deprehendatur ad tactum.

21. Fimus equinus, et hujusmodi excrementa animalium recentia.

22. Oleum forte sulphuris[31] et vitrioli exequitur opera caloris, in linteo adurendo.

23. Oleum origani[32], et hujusmodi, exequitur opera caloris in adurendis ossibus dentium.

24. Spiritus vini fortis et bene rectificatus exequitur opera caloris; adeo ut si albumen ovi in eum injiciatur, concrescat et albescat, fere in modum albuminis cocti; panis injectus torrefiat et incrustetur, ad modum panis tosti.

25. Aromata, et herbæ calidæ, ut dracunculus[33], nasturtium vetus, &c. licet ad manum non sint calida, (nec integra, nec pulveres eorum) tamen ad linguam et palatum parum masticata percipiuntur calida, et quasi adurentia.

26. Acetum forte, et omnia acida, in membro ubi non sit epidermis, ut in oculo, lingua, aut aliqua alia parte vulnerata, et cute detecta, dolorem cient, non multum discrepantem ab eo, qui inducitur a calido.

27. Etiam frigora acria et intensa inducunt sensum quendam ustionis[34];

[31] "Oleum sulphuris et vitrioli." By these two names Bacon probably means the same thing, viz. Sulphuric Acid, which is an oil-like fluid, and, when mixed with water, produces considerable heat.

[32] "Oleum origani." The *essential oils* of vegetable substances, of which this *Oil of Marjoram* is one, are acrid and caustic, and readily combustible on the approach of burning bodies.

[33] Dracunculus. "Artemisia Drac." of Linnæus. Herschel (Discourse on Nat. Phil. § 345.) points out the confusion in these Instances (22–25) between things really hot, and those "which excite in our organs, and chiefly in that of taste, a sensation of heat, which they owe to their being Chemical stimulants, and not at all to their being actually hot."

[34] A mistake analogous to the

Nam Boreæ penetrabile frigus adurit.

28. Alia.

Hanc *tabulam essentiæ et præsentiæ* appellare consuevimus.

XII.

Secundo[35], facienda est *comparentia* ad intellectum *instantiarum*, quæ natura data privantur: quia forma (ut dictum est[36]) non minus abesse debet, ubi natura data abest, quam adesse, ubi adest. Hoc vero infinitum esset in omnibus.

Itaque subjungenda sunt *negativa affirmativis*, et privationes inspiciendæ tantum in illis subjectis, quæ sunt maxime cognata illis alteris, in quibus natura data inest et comparet. Hanc *tabulam declinationis*, sive *absentiæ in proximo*[37], appellare consuevimus.

Instantiæ in proximo, quæ privantur natura calidi. *Ad Instantiam primam affirmativam Instantia prima negativa vel subjunctiva.*

1. Lunæ, et stellarum, et cometarum radii non inveniuntur calidi ad tactum: quinetiam observari solent acerrima frigora in pleniluniis[38].

At stellæ fixæ majores, quando sol eas subit, aut iis

above, arising from men's arguing from their own sensations to things causing them. The line quoted is from Virgil, Georg. i. 93. For a discussion of most of the sources of Heat here given, see below.

[35] This Table is not merely one of *Negatives*, but includes supplementary observations and chance limitations. It is "*negativa vel subjunctiva.*" One may notice its great ignorance of Chemical truths — a faithful sign (for Bacon was not behind his contemporaries in most things) of the want of scientific knowledge in his day; and also its great attention. It is an admirable record of an active mind, and fulfils his own saying: "Sol æque palatia et cloacas ingreditur, neque tamen polluitur." (I. 120.)

[36] Supra, II. 4.

[37] *In proximo*, i. e. "in illis subjectis, quæ sunt maxime cognata illis alteris, in quibus natura data inest comparet."

[38] The cold at full moon probably arises from the fact that the clearest weather usually occurs at that time, as the moon causes evaporation of clouds, and gives opportunity for rarefaction of the atmosphere. But see infr. Instance 5. (note 45.)

approximatur, existimantur fervores solis augere et intendere; ut fit cum sol sistitur in leone, et diebus canicularibus[39].

Ad secundam.

2. Radii solis in media (quam vocant) regione aëris non calefaciunt; cujus ratio vulgo non male redditur; quia regio illa nec satis appropinquat ad corpus solis, unde radii emanant, nec etiam ad terram, unde reflectuntur[40]. Atque hoc liquet ex fastigiis montium, (nisi sint præalti) ubi nives perpetuo durant. Sed contra notatum est a nonnullis, quod in cacumine Picus de Tenariph, atque etiam in Andis Peruviæ, ipsa fastigia montium nive destituta sint; nivibus jacentibus tantum inferius in ascensu[41]. Atque insuper aër in illis

[39] This is erroneous: the fixed stars have no influence of the kind; and the cause of the increased Heat of the sun in Leo, or in the Dog-days, arises from the angle at which the Earth's Axis is inclined, and from the Heat increasing to a maximum after the Sun has passed the Summer Solstice. "Sol iis approximatur" is language connected with the belief that the Sun and the Stars are equidistant from the earth.

[40] Accounted for by the Rarefaction of the Atmosphere as we ascend, which proceeds by a direct ratio as the pressure decreases. Reflection of Rays is also a cause of additional Heat, but does not account for this phenomenon.

The Solar Ray has been analysed carefully, and is found to be divisible into three distinct kinds of beams; (1) rays of Heat not luminous, (2) rays of light not hot, and (3) the actinic rays, which alone produce those chemical results upon silver and other substances, which are applied in Photography.

[41] These extreme heights may not be snow-clad, but if so, only because there is not a sufficiently level surface for the snow to rest. The belief as to the stillness on the summit of Olympus is to be found in Homer.

Ἡ μὲν ἄρ' ὣς εἰποῦσ' ἀπέβη γλαυκῶπις Ἀθήνη
Οὔλυμπόνδ', ὅθι φασὶ θεῶν ἕδος ἀσφαλὲς αἰεὶ
ἔμμεναι· οὔτ' ἀνέμοισι τινάσσεται, οὔτε ποτ' ὄμβρῳ
δεύεται, οὔτε χιὼν ἐπιπίλναται· ἀλλὰ μάλ' αἴθρη
πέπταται ἀνέφελος, λευκὴ δ' ἐπιδέδρομεν αἴγλη. Od. vi. 41.

So too Lucan, Phars. II. 269–273. But the authority whom Bacon must have had before him was Solinus, Polyhist. chap. xiii. "Ara est in cacumine Jovi dicata, cujus altaribus signa de extis inferuntur, nec difflantur ventosis spiritibus, nec pluviis diluuntur, sed volvente

ipsis verticibus montium deprehenditur minime frigidus, sed tenuis tantum et acer; adeo ut in Andis pungat et vulneret oculos per nimiam acrimoniam, atque etiam pungat os ventriculi, et inducat vomitum. Atque ab antiquis notatum est, in vertice Olympi tantam fuisse aëris tenuitatem, ut necesse fuerit illis, qui eo ascenderant, secum deferre spongias aceto et aqua madefactas, easque ad os et nares subinde apponere; quia aër ob tenuitatem non sufficiebat respirationi. In quo vertice etiam relatum est tantam fuisse serenitatem et tranquillitatem a pluviis, et nivibus, et ventis, ut sacrificantibus literæ descriptæ digito in cineribus sacrificiorum super aram Jovis manerent in annum proximum absque ulla perturbatione. Atque etiam hodie ascendentes ad verticem Picus de Tenariph, eo vadunt noctu et non interdiu; et paulo post ortum solis monentur et excitantur a ducibus suis, ut festinent descendere, propter periculum (ut videtur) a tenuitate aëris, ne solvat spiritus et suffocet[42].

Ad secundam.

3. Reflexio radiorum solis, in regionibus prope circulos polares, admodum debilis et inefficax invenitur in calore[42]: adeo ut Belgæ, qui hybernarunt in Nova Zembla, cum expectarent navis suæ liberationem et deobstructionem a glaciali mole (quæ eam obsederat) per initia mensis Julii spe sua frustrati sint, et coacti scaphæ se committere. Itaque radii solis directi viden-

altero anno, cujusmodi relicta fuerint, ejusmodi reperiuntur. Et omnibus tempestatibus a corruptelis aurarum vindicatur quicquid ibi semel est Deo consecratum. Literæ in cinere scriptæ usque ad alteram anni ceremoniam permanent." Bacon repeats these instances in his History of Winds.

[42] The snow is safer then; the reflection of the Sun's rays on the Snow is avoided by ascending by night; and the view is usually finest an hour or two after sunrise.

[43] This case (as also others) is one of *Degree*, and not negative.

tur parum posse, etiam super terram planam; nec reflexi etiam, nisi multiplicentur et uniantur, quod fit, cum sol magis vergit ad perpendiculum; quia tum incidentia radiorum facit angulos acutiores; ut lineæ radiorum sint magis in propinquo: ubi contra in magnis obliquitatibus solis, anguli sunt valde obtusi, et proinde lineæ radiorum magis distantes[43]. Sed interim notandum est, multas esse posse operationes radiorum solis, atque etiam ex natura calidi, quæ non sunt proportionatæ ad tactum nostrum: adeo ut respectu nostri non operentur usque ad calefactionem, sed respectu aliorum nonnullorum corporum exequantur opera calidi.

Ad secundam.

4. Fiat hujusmodi experimentum. Accipiatur speculum fabricatum contra ac fit in speculis comburentibus; et interponatur inter manum et radios solis; et fiat observatio, utrum minuat calorem solis, quemadmodum speculum comburens eundem auget et intendit. Manifestum est enim quoad radios opticos, prout fabricatur speculum in densitate inæquali respectu medii et laterum, ita apparere simulacra magis diffusa, aut magis contracta. Itaque idem videndum in calore[44].

Ad secundam.

5. Fiat experimentum diligenter, utrum per specula

[43] The rays have a less amount of atmosphere to traverse when the Sun is in zenith; and what reflection there is is most direct. But the question of Solar Heat is in itself very obscure, and but little understood. Herschel's Disc. on Nat. Phil. § 347. "The nature of the Sun, and the mode in which its wonderful supply of light and heat is maintained, are involved in a mystery which every discovery that has been made either in chemistry or optics, so far from elucidating, seems only to render more profound."

[44] This can be verified. Solar Rays naturally increase or decrease the amount of Heat generated at a certain point according to the number of them (if one may so speak) brought to bear on that point.

comburentia, fortissime et optime fabricata, radii lunæ possint excipi et colligi in aliquem vel minimum gradum teporis[45]. Is vero gradus teporis, si fortasse nimis subtilis et debilis fuerit, ut ad tactum percipi et deprehendi non possit; confugiendum erit ad vitra illa, quæ indicant constitutionem aëris calidam aut frigidam[46]; ita ut radii lunæ per speculum comburens incidant et jaciantur in summitatem vitri hujusmodi; atque tum notetur, si fiat depressio aquæ per teporem.

Ad secundam.

6. Practicetur etiam vitrum comburens super calidum, quod non sit radiosum aut luminosum; ut ferri, et lapidis calefacti, sed non igniti; aut aquæ ferventis, aut similium: et notetur, utrum fiat augmentum et intentio calidi, ut in radiis solis[47].

[45] This experiment has been performed as follows: Tschirnhausen made a lens of power sufficient to fuse copper, silver, tiles, pumice, and even a crucible; but the rays of the full moon at her greatest altitude produced no perceptible degree of Heat. In 1802 the lunar rays were again concentrated by the most powerful lens ever made, in the presence of Sir Joseph Banks and other Members of the Royal Society; but though the most sensitive Thermometers were applied, it was thought that a diminution rather than an increase of Heat took place. Encycl. Brit. "Burning-glass."

[46] "Vitrum Calendare." Cf. infr. II. 13. No. 38. It served also as a barometer, but was naturally rude and inaccurate. For a history of the Thermometer see Herschel's Disc. on Nat. Phil. § 356.

[47] See the Encycl. Brit. Article "Burning Glass." The questions started here and in the next paragraph have been settled; and the result is such as proves the similarity in kind of Solar and other Heat; so that in these places no *Negative* can be adduced. Large lenses brought before lighted candles or the fire produce sensible Heat; and by collecting the rays of Heat in the atmosphere, even when the Sun is quite hidden behind clouds, concave Mirrors produce a definite increase of Heat at their focus. Farther than this, M. M. Saussure and Pictet of Geneva have established the truth as to "ferrum, vel lapis calefactus, sed non ignitus," &c. by heating an iron ball so as not to be luminous, and by experimenting on boiling water. From the results they have shewn that Heat emanates in invisible rays, and is subject to the same laws of reflection, &c. as if it were accompanied by rays of light as well. Melloir has also established

Ad secundam.

7. Practicetur etiam speculum comburens in flamma communi.

Ad tertiam.

8. Cometarum (si et illos numerare inter meteora libuerit) non deprehenditur constans aut manifestus effectus in augendis ardoribus anni, licet siccitates sæpius inde sequi notatæ sint[48]. Quinetiam trabes, et columnæ lucidæ, et chasmata[49], et similia, apparent sæpius temporibus hybernis, quam æstivis; et maxime per intensissima frigora, sed conjuncta cum siccitatibus[50]. Fulmina tamen et coruscationes et tonitrua raro eveniunt hyeme, sed sub tempus magnorum fervorum[51]. At stellæ (quas vocant) cadentes, existimantur vulgo magis constare ex viscosa aliqua materia splendida et accensa, quam esse naturæ igneæ fortioris[52]. Sed de hoc inquiratur ulterius.

the fact that Heat is refrangible; and (like Light of different colours) Heat from different sources has different degrees of refrangibility. Forbes has established the polarization of Heat from both luminous and non-luminous sources: he also depolarized Heat; and as this is a consequence solely of double refraction, he thereby has proved that Heat is subject also to the Laws of double refraction. See Turner's Chemistry, Heat, p. 14—20.

48 Comets (as Bacon apparently thought) have no effect on either Heat or Drought, except perhaps when they approach so near our planet as to affect the Atmosphere. The belief to the contrary is still almost universal.

49 *Trabes, columnæ, chasmata* are all described by Seneca. *Trabes* "longa fax, trabis specie, in cœlo apparens." Quæst. Nat. vii. 4. *Columnæ*. Quæst. Nat. vii. 20. *Chasma*, "quum aliquod cœli spatium discedit, et flammam dehiscens velut in abdito ostendat." Quæst. Nat. i. 14. They are clearly names for the Aurora Borealis.

50 The Aurora Borealis is probably caused by electricity, which is most active when the weather is dry.

51 This is now accounted for by what is known of Electricity; yet thunderstorms do sometimes occur in Winter.

52 For the probable nature and cause of falling stars, see Herschel's Elements of Astronomy, part III. chap. xvii. § 898; and Humboldt's Kosmos.

Ad quartam.

9. Sunt quædam coruscationes, quæ præbent lumen, sed non urunt: eæ vero semper fiunt sine tonitru [53].

Ad quintam.

10. Eructationes et eruptiones flammarum inveniuntur non minus in regionibus frigidis quam calidis; ut in Islandia et Groenlandia: quemadmodum et arbores per regiones frigidas magis sunt quandoque inflammabiles, et magis piceæ ac resinosæ, quam per regiones calidas; ut fit in abiete, pinu, et reliquis: verum in quali situ et natura soli hujusmodi eruptiones fieri soleant, ut possimus *affirmativæ* subjungere *negativam*, non satis quæsitum est [54].

Ad sextam.

11. Omnis flamma perpetuo est calida magis aut minus: neque omnino subjungitur *negativa* [55]. Et tamen referunt, ignem fatuum [56], (quem vocant) qui etiam aliquando impingitur in parietem, non multum habere caloris; fortasse instar flammæ spiritus vini, quæ clemens et lenis est. Sed adhuc lenior videtur ea flamma, quæ in nonnullis historiis fidis et gravibus invenitur apparuisse circa capita et comas puerorum et virgi-

[53] Sheet lightning is supposed to be only the reflection of ordinary lightning.

[54] This is clearly no *Negative*. For the causes and nature of subterraneous fires, see Dr. Daubeny on Volcanoes.

[55] This is again an instance of Degree. One can however imagine rays of light without any Heat, such as would be the Halos which encircle holy heads in Paintings. The flames of different substances have different degrees of Heat, arising from the different amounts of gases disengaged.

[56] *Ignis fatuus* is seen only in marshy and other spots where there are exhalations of decomposing matter. It has been variously accounted for by Sir I. Newton and Dr. Priestly; nothing is certainly known about it; possibly it is caused by phosphoretted Hydrogen, kindled either by Electricity, or by its own tendency to combustion in air. The flame of Spirits of Wine, instead of being "clemens et lenis," is one of the most intensely hot kinds of flame.

num[57]; quæ nullo modo comas adurebat, sed molliter circum eas trepidabat. Atque certissimum est, circa equum in itinere sudantem, noctu et suda tempestate, apparuisse quandoque coruscationem quandam absque manifesto calore. Atque paucis abhinc annis notissimum est, et pro miraculo quasi habitum, gremiale cujusdam puellæ paulo motum aut fricatum coruscasse: quod fortasse factum est ob alumen aut sales, quibus gremiale tinctum erat, paulo crassius hærentia et incrustata, et ex fricatione fracta[58]. Atque certissimum est, saccharum omne, sive conditum (ut vocant) sive simplex, modo sit durius, in tenebris fractum aut cultello scalptum coruscare. Similiter aqua marina et salsa, noctu interdum invenitur, remis fortiter percussa, coruscare. Atque etiam in tempestatibus spuma maris fortiter agitata noctu coruscat; quam coruscationem Hispani pulmonem marinum vocant[59]. De illa flamma autem, quam antiqui nautæ vocabant Castorem et Pollucem, et moderni Focum Sancti Ermi[60], qualem calorem habeat, non satis quæsitum est.

[57] Cf. Livy, I. 39. Virg. Æn. II. 682–686.

[58] The girl's Apron was probably made of silk, and the "coruscatio" electric.

[59] It is not quite certain to what cause this "Phosphorescent Light" is to be attributed. Ehrenberg, Darwin, and Schönbein all agree in rejecting the notion that it is caused by infusoria in the water; and the most probable conclusion is that it is caused by the process of self-purification, continually going on in salt water. Ozone (a product of Phosphorus) oxidates Phosphorus, and by so doing causes emission of light. So, probably, when the sea is in motion, (and at no other time is the light seen,) new particles of organic matter are brought into contact with the oxygen of the air; then ozone is produced, which oxidates and destroys the vegetable matter from which it sprang, and during this process the "coruscatio" takes place. Darwin adds a remark which illustrates the Spanish "Pulmon marino"—the *Lungs* of the Sea. "I am inclined to consider that the phosphorescence is the result of decomposition of the organic particles, by which process (one is tempted almost to call it *a kind of respiration*) the ocean becomes purified.

[60] *Focus Sancti Ermi.* "St. Elmo's fire;" an electric light. An

Ad septimam.

12. Omne ignitum ita ut vertatur in ruborem igneum, etiam sine flamma perpetuo calidum est; neque huic *affirmativæ* subjungitur *negativa:* sed quod in proximo est, videtur esse lignum putre; quod splendet noctu, neque tamen deprehenditur calidum: et squamæ piscium putrescentes, quæ etiam splendent noctu[61], nec inveniuntur ad tactum calidæ: neque etiam corpus cicindelæ, aut muscæ, (quam vocant luciolam[62]) calidum ad tactum deprehenditur.

Ad octavam.

13. De balneis calidis, in quo situ et natura soli emanare soleant, non satis quæsitum est: itaque non subjungitur *negativa.*

Ad nonam.

14. Liquidis ferventibus subjungitur *negativa* ipsius liquidi natura sua. Nullum enim invenitur liquidum tangibile, quod sit in natura sua et maneat constanter calidum; sed superinducitur ad tempus tantum calor, ut natura ascititia: adeo ut quæ potestate et operatione sunt maxime calida, ut spiritus vini, olea aromatum chemica, etiam olea vitrioli et sulphuris, et similia[63], quæ paulo post adurunt, ad primum tactum sint frigida. Aqua autem balneorum naturalium, excepta in vas aliquod, et separata a fontibus suis, defervescit perinde ac aqua igne calefacta. At verum est, corpora oleosa ad tactum paulo minus esse frigida quam aquea; ut oleum

account of it, with its supposed effect on weather, is given by Bacon in his History of Winds.

[61] Arises from the disengagement of Phosphorescent light during decomposition.

[62] The glow-worm and the Italian firefly: "Lucciola" is its present name. These also give off Phosphorescent light. For its manner and process of disengagement, we may refer to note 59.

[63] See supr. II. 11. (note 33.)

minus quam aqua, sericum minus quam linteum. Verum hoc pertinet ad *Tabulam graduum* de frigido[64].

Ad decimam.

15. Similiter vapori fervido subjungitur *negativa* naturæ ipsius vaporis, qualis apud nos invenitur. Etenim exhalationes ex oleosis, licet facile inflammabiles, tamen non inveniuntur calidæ, nisi a corpore calido recenter exhalaverint.

Ad decimam.

16. Similiter aëri ipsi ferventi subjungitur *negativa* naturæ aëris ipsius. Neque enim invenitur apud nos aër calidus, nisi fuerit aut conclusus, aut attritus[65], aut manifeste calefactus a sole, igne, aut aliquo alio corpore calido.

Ad undecimam.

17. Subjungitur *negativa* tempestatum frigidarum magis quam pro ratione temporis anni, quæ eveniunt apud nos flante Euro et Borea: quemadmodum et contrariæ tempestates eveniunt flante Austro et Zephyro. Etiam inclinatio ad pluviam (præsertim temporibus hyemalibus) comitatur tempestatem tepidam: at gelu contra frigidam.

Ad duodecimam.

18. Subjungitur *negativa* aëris conclusi in cavernis tempore æstivo[66]. At de aëre concluso omnino dili-

[64] The Theory of "Absolute Cold" was believed in in Bacon's days. We again notice here the confusion of notions between things really hot, and those which have similar chemical effects.

[65] Cf. infr. inst. 22. By *Aer attritus* would probably be meant air when compressed, or when friction is going on.

[66] The cause of this will be this: that in Summer the Sun's rays, which heighten the outer temperature, cannot affect the air in caverns, and so they are cooler than the open air is: just as thick-walled buildings enjoy a comparatively equable temperature. The case with air generally is, (and this answers most of the difficulties expressed here,) that it is a very bad conductor of Heat, and so receives it slowly, and retains it long.

gentius inquirendum. Primo enim non absque causa in dubitationem venit, qualis sit natura aëris, quatenus ad calidum et frigidum in natura sua propria. Recipit enim aër calidum manifesto ex impressione cœlestium; frigidum autem fortasse ab expiratione terræ; et rursus in media (quam vocant) regione aëris, a vaporibus frigidis et nivibus: ut nullum judicium fieri possit de aëris natura per aërem, qui foras est et sub dio, sed verius foret judicium per aërem, conclusum. Atqui opus est etiam ut aër concludatur in tali vase et materia, quæ nec ipsa imbuat aërem calido vel frigido ex vi propria, nec facile admittat vim aëris extranei. Fiat itaque experimentum per ollam figularem multiplici corio obductam ad muniendam ipsam ab aëre extraneo, facta mora per tres aut quatuor dies in vase bene occluso: deprehensio autem sit post apertionem vasis, vel per manum, vel per vitrum graduum ordine applicatum.

Ad decimam tertiam.

19. Subest similiter dubitatio, utrum tepor in lana, et pellibus, et plumis, et hujusmodi, fiat ex quodam exili calore inhærente, quatenus excernuntur ab animalibus; aut etiam ob pinguedinem quandam et oleositatem, quæ sit naturæ congruæ cum tepore; vel plane ob conclusionem et fractionem aëris, ut in articulo præcedente dictum est. Videtur enim omnis aër, abscissus a continuitate aëris forinseci, habere nonnihil teporis. Itaque fiat experimentum in fibrosis, quæ fiunt ex lino; non ex lana, aut plumis, aut serico, quæ excernuntur ab animatis. Notandum est etiam, omnes pulveres (ubi manifesto includitur aër) minus esse frigidos, quam corpora integra ipsorum; quemadmodum etiam existimamus, omnem spumam (utpote quæ aërem contineat) minus esse frigidam, quam liquorem ipsum.

Ad decimam quartam.

20. Huic non subjungitur *negativa*. Nihil enim reperitur apud nos sive tangibile, sive spirituale[67], quod admotum igni non excipiat calorem. In eo tamen differunt, quod alia excipiant calorem citius, ut aër, oleum, et aqua; alia tardius, ut lapis et metalla. Verum hoc pertinet ad *Tabulam graduum*.

Ad decimam quintam.

21. Huic instantiæ non subjungitur *negativa* alia, quam ut bene notetur, non excitari scintillas ex silice et chalybe, aut alia aliqua substantia dura, nisi ubi excutiuntur minutiæ aliquæ ex ipsa substantia lapidis vel metalli: neque aërem attritum unquam per se generare scintillas, ut vulgo putant[68]: quin et ipsæ illæ scintillæ ex pondere corporis igniti magis vergunt deorsum quam sursum, et in extinctione redeunt in quandam fuliginem corpoream.

Ad decimam sextam.

22. Existimamus huic instantiæ non subjungi *negativam*. Nullum enim invenitur apud nos corpus tangibile, quod non ex attritione manifesto calescat[69]; adeo ut veteres somniarent, non inesse cœlestibus aliam vim aut virtutem calefaciendi, nisi ex attritione aëris per rotationem rapidam et incitatam. Verum in hoc

[67] An old Scholastic division. By "spirituale" Bacon probably here means such things as Gases. His view of the relative speed of different substances in acquiring heat is all wrong. Air (as it is so bad a conductor) is very slow: Metals are particularly rapid; but because of the far greater number of their particles, they do not shew it so quickly; and for the same reason they carry off Heat far more rapidly, and so seem colder to the touch.

[68] Air under compression does emit sparks of sufficient intensity to ignite German tinder.

[69] Friction is one of the most important sources of Heat; as Count Rumford's experiments have proved that an unlimited supply of Heat can be obtained by it without diminishing the quantity of the materials.

genere ulterius inquirendum est, utrum corpora, quæ emittuntur ex machinis, (qualia sunt pilæ ex tormentis) non ex ipsa percussione contrahant aliquem gradum caloris; adeo ut postquam deciderint, inveniantur nonnihil calida. At aër motus magis infrigidat quam calefacit; ut in ventis, et follibus, et flatu oris contracti[70]. Verum hujusmodi motus non est tam rapidus ut excitet calorem; et fit secundum totum, non per particulas: ut mirum non sit, si non generet calorem.

Ad decimam septimam.

23. Circa hanc instantiam facienda est inquisitio diligentior. Videntur enim herbæ et vegetabilia viridia et humida aliquid habere in se occulti caloris. Ille vero calor tam tenuis est, ut in singulis non percipiatur ad tactum: verum postquam illa adunata sint et conclusa, ut spiritus ipsorum non expiret in aërem, sed se invicem foveat[71]; tum vero oritur calor manifestus, et nonnunquam flamma in materia congrua.

Ad decimam octavam.

24. Etiam circa hanc instantiam diligentior facienda est inquisitio. Videtur enim calx viva, aqua aspersa, concipere calorem; vel propter unionem caloris, qui antea distrahebatur, (ut ante dictum est herbis conclu-

[70] Bodies passing through Air become hot by friction—as Meteors: but Air in Motion causes coolness, because of its carrying off the Caloric of the Body. The radiation of Heat from a body is more rapid when the Heat is continually being removed by a current of Air, and the equilibrium of Heat thereby hindered. The contrary effect is produced when the radiation of Heat from bodies is impeded (cf. supra Inst. 19) by thick and close coverings of wool or skin. "Fit secundum totum, non per particulas." By this, I suppose, Bacon means, it affects the whole body generally, and does not cause friction of its separate particles. This view is of course wrong.

[71] So damp hayricks are set on fire. The close confinement of Air creates great Heat; and there is a process of fermentation going on also.

sis) vel ob irritationem et exasperationem spiritus ignei ab aqua, ut fiat quidam conflictus et antiperistasis [72]. Utra vero res sit in causa, facilius apparebit, si loco aquæ immittatur oleum. Oleum enim æque ac aqua valebit ad unionem spiritus inclusi, sed non ad irritationem. Etiam faciendum est experimentum latius, tam in cineribus et calcibus diversorum corporum, quam per immissionem diversorum liquorum [73].

Ad decimam nonam.

25. Huic instantiæ subjungitur *negativa* aliorum metallorum, quæ sunt magis mollia et fluxa. Etenim bracteolæ auri, solutæ in liquorem per aquam regis [74], nullum dant calorem ad tactum in dissolutione: neque similiter plumbum in aqua forti. Neque etiam argentum vivum, (ut memini) sed argentum ipsum parum excitat caloris, atque etiam cuprum, (ut memini) sed magis manifesto stannum, atque omnium maxime ferrum et chalybs; quæ non solum fortem excitant calorem in dissolutione, sed etiam violentam ebullitionem. Itaque videtur calor fieri per conflictum, cum aquæ fortes penetrant et fodiunt, et divellunt partes corporis,

[72] *ἀντιπερίστασις*, "the strengthening of a principle by the influence of its opposite." (Glossary to Sir T. Browne's Rel. Med.) Cf. infr. II. 27. 48. Sir T. Browne uses the Term Rel. Med. II. § 10. Below, II. 27 (ad fin.), Bacon writes thus—"per antiperistasin sive *rejectionem naturæ contrariæ*"—which would give it quite a different sense. In the same sense it occurs in II. 48: as the *driving* out rather than the *irritation* and strengthening of one principle by its contrary. Bacon's suggestion of substituting oil has been tried successfully. In fact any liquid applied to quicklime, in passing into a solid state, gives off violent Heat.

[73] The caustic properties of quicklime are explained by Dr. Black by the principle of Latent Heat. See Encycl. Brit.

[74] *Aqua regis*, a compound of nitric and hydro-chloric Acid in different proportions, according to the purpose for which it is intended. It is particularly used to dissolve Gold, being its only solvent. It also dissolves other metals, but not Silver. See below, Inst. 28. *Aqua fortis* is strong nitric acid.

et corpora ipsa resistunt. Ubi vero corpora facilius cedunt, vix excitatur calor.

Ad vicesimam.

26. Calori animalium nulla subjungitur *negativa*, nisi insectorum (ut dictum est) ob parvitatem corporis. Etenim in piscibus collatis ad animalia terrestria magis notatur gradus caloris, quam privatio. In vegetabilibus autem et plantis nullus percipitur gradus caloris ad tactum, neque in lachrymis ipsorum, neque in medullis recenter apertis. At in animalibus magna reperitur diversitas caloris; tum in partibus ipsorum, (alius est enim calor circa cor, alius in cerebro, alius circa externa) tum in accidentibus eorum, ut in exercitatione vehementi, et febribus.

Ad vicesimam primam.

27. Huic instantiæ vix subjungitur *negativa*. Quinetiam excrementa animalium non recentia manifeste habent calorem potentialem, ut cernitur in impinguatione soli [75].

Ad vicesimam secundam et tertiam.

28. Liquores (sive aquæ vocentur, sive olea) qui habent magnam et intensam acrimoniam, exsequuntur opera caloris in divulsione corporum, atque adustione post aliquam moram: sed tamen ad ipsum tactum manus non sunt calidi ab initio [76]. Operantur autem secundum analogiam, et poros corporis, cui adjunguntur. Aqua enim regis aurum solvit, argentum minime: at

[75] From the Ammonia contained in all dung.

[76] Repetition from Instance 14, with an attempt at explanation. "Secundum Analogiam," "according to their Affinities," does Bacon mean? These "exceptions" (28—32) are in no sense connected with Heat; as has been observed above, II. 11. Inst. 25.

contra, aqua fortis argentum solvit, aurum minime: neutrum autem solvit vitrum. Et sic de cæteris.

Ad vicesimam quartam.

29. Fiat experimentum spiritus vini in lignis, ac etiam in butyro, aut cera, aut pice; si forte per calorem suum ea aliquatenus liquefaciat[77]. Etenim instantia vicesima quarta ostendit potestatem ejus imitativam caloris in incrustationibus. Itaque fiat similiter experimentum in liquefactionibus. Fiat etiam experimentum per vitrum graduum sive calendare, quod concavum sit in summitate sua per exterius; et immittatur in illud concavum exterius spiritus vini bene rectificatus, cum operculo, ut melius contineat calorem suum; et notetur utrum per calorem suum faciat aquam descendere.

Ad vicesimam quintam.

30. Aromata, et herbæ acres ad palatum, multo magis sumptæ interius, percipiuntur calida. Videndum itaque in quibus aliis materiis exequantur opera caloris. Atque referunt nautæ, cum cumuli et massæ aromatum diu conclusæ subito aperiuntur, periculum instare illis, qui eas primo agitant et extrahunt, a febribus et inflammationibus spiritus. Similiter fieri poterit experimentum, utrum pulveres hujusmodi aromatum aut herbarum non arefaciant laridum, et carnem suspensam super ipsos, veluti fumus ignis.

Ad vicesimam sextam.

31. Acrimonia sive penetratio inest tam frigidis, qualia sunt acetum, et oleum vitrioli, quam calidis, qualia sunt oleum origani, et similia. Itaque similiter et in animatis cient dolorem, et in non animatis divel-

[77] Spirits of Wine will solve wax and pitch, but not wood or butter.

lunt partes et consumunt. Neque huic instantiæ subjungitur *negativa*. Atque in animatis nullus reperitur dolor, nisi cum quodam sensu caloris[78].

Ad vicesimam septimam.

32. Communes sunt complures actiones et calidi et frigidi, licet diversa admodum ratione. Nam et nives puerorum manus videntur paulo post urere; et frigora tuentur carnes a putrefactione[79], non minus quam ignis; et calores contrahunt corpora in minus, quod faciunt et frigida. Verum hæc et similia opportunius est referre ad inquisitionem de frigido.

XIII.

Tertio facienda est *comparentia ad intellectum* instantiarum in quibus natura, de qua fit inquisitio, inest secundum magis et minus; sive facta comparatione incrementi et decrementi in eodem subjecto, sive facta comparatione ad invicem in subjectis diversis. Cum enim forma rei sit ipsissima res; neque differat res a forma aliter quam differunt apparens et existens, aut exterius et interius, aut in ordine ad hominem et in ordine ad universum; omnino sequitur, ut non recipiatur aliqua natura pro vera forma, nisi perpetuo decrescat, quando natura ipsa decrescit, et similiter perpetuo augeatur, quando natura ipsa augetur[80]. Hanc itaque tabulam, *Tabulam graduum* sive *Tabulam comparativæ* appellare consuevimus.

Tabula graduum, sive Comparativæ in Calido.

Primo itaque dicemus de iis, quæ nullum prorsus

[78] An unfounded assertion.

[79] It is worth noticing that it was an experiment on the power of cold to preserve bodies that cost Bacon his life; for he caught a cold and inflammation while stuffing a fowl with snow at Highgate, and died on the 9th April 1626.

[80] This language is the same with that in II. 4. "In ordine ad hominem, &c." corresponds to the modern technical Terms "subjective" and "objective."

gradum caloris habent ad tactum; sed videntur habere potentialem tantum quendam calorem, sive dispositionem et præparationem ad calidum. Postea demum descendemus ad ea, quæ sunt actu sive ad tactum calida, eorumque fortitudines et gradus.

1. In corporibus solidis et tangibilibus non invenitur aliquid, quod in natura sua calidum sit originaliter[81]. Non enim lapis aliquis, non metallum, non sulphur, non fossile aliquod, non lignum, non aqua, non cadaver animalis, inveniuntur calida. Aquæ autem calidæ in balneis videntur calefieri per accidens, sive per flammam aut ignem subterraneum, qualis ex Ætna et montibus aliis compluribus evomitur[82]; sive ex conflictu corporum, quemadmodum calor fit in ferri et stanni dissolutionibus. Itaque gradus caloris in inanimatis, quatenus ad tactum humanum, nullus est; veruntamen illa gradu frigoris differunt; non enim æque frigidum est lignum, ac metallum. Sed hoc pertinet ad Tabulam graduum in frigido.
2. Attamen quoad potentiales calores et præparationes ad flammam, complura inveniuntur inanimata admodum disposita, ut sulphur, naphtha, petroleum.
3. Quæ antea incaluerunt, ut fimus equinus ex animali, aut calx, aut fortasse cinis, aut fuligo ex igne, reliquias latentes quasdam caloris prioris retinent[83].

[81] This Instance is totally wrong. All bodies are endued with Heat more or less; all aggregations of particles have some degree of Heat in them; and the reason why Metal is colder to the touch than Wood is not that it has more inherent cold in it, but simply because of the greater density of its particles, which carry off a far greater quantity of Caloric. See note 67.

[82] All that is known upon the subject of the origin of Volcanic fire is to be found in Dr. Daubeny's Treatise on Volcanos. Cf. supr. II. 12. Inst. 10.

[83] "Reliquiæ Latentes" must not be mistaken for "Latent Heat," which was not discovered till Dr. Black's experiments. (Herschel's Discourse on Nat. Phil. § 360, 361.) Turner's Chemistry, Art. Heat.

Itaque fiunt quædam distillationes et separationes corporum, per sepulturam in fimo equino; atque excitatur calor in calce per aspersionem aquæ; ut jam dictum est.

4. Inter vegetabilia non invenitur aliqua planta, sive pars plantæ, (veluti lachryma, aut medulla) quæ sit ad tactum humanum calida. Sed tamen (ut superius dictum est) herbæ virides conclusæ calescunt; atque ad interiorem tactum, veluti ad palatum, aut ad stomachum[84], aut etiam ad exteriores partes post aliquam moram (ut in emplastris et unguentis) alia vegetabilia inveniuntur calida, alia frigida.

5. Non invenitur in partibus animalium, postquam fuerint mortuæ aut separatæ, aliquid calidum ad tactum humanum. Nam neque fimus equinus ipse, nisi fuerit conclusus et sepultus, calorem retinet. Sed tamen omnis fimus habere videtur calorem potentialem, ut in agrorum impinguatione. Et similiter cadavera animalium hujusmodi habent latentem et potentialem calorem; adeo ut in cœmeteriis, ubi quotidie fiunt sepulturæ, terra calorem quendam occultum colligat, qui cadaver aliquod recenter impositum consumit longe citius quam terra pura[85]. Atque apud orientales traditur inveniri textile quoddam tenue et molle, factum ex avium plumagine, quod vi innata butyrum solvat et liquefaciat, in ipso leviter involutum[86].

6. Quæ impinguant agros, ut fimi omnis generis, creta, arena maris, sal, et similia, dispositionem nonnullam habent ad calidum.

[84] This same instance is introduced in Table ii, and shews how very roughly Bacon has thrown his examples together.

[85] There is no ground for this assertion.

[86] This might readily happen, if the wrapping was such as to confine the Air very closely.

7. Omnis putrefactio in se rudimenta quædam exilis caloris habet, licet non hucusque, ut ad tactum percipiatur. Nam nec ea ipsa, quæ putrefacta solvuntur in animalcula[87], ut caro, caseus, ad tactum percipiuntur calida; neque lignum putre, quod noctu splendet[88], deprehenditur ad tactum calidum. Calor autem in putridis quandoque se prodit per odores tetros et fortes.

8. Primus itaque caloris gradus ex iis, quæ ad tactum humanum percipiuntur calida, videtur esse calor animalium, qui bene magnam habet graduum latitudinem; nam infimus gradus (ut in insectis) vix ad tactum deprehenditur; summus autem gradus vix attingit ad gradum caloris radiorum solis in regionibus et temporibus maxime ferventibus; neque ita acris est, quin tolerari possit a manu. Et tamen referunt de Constantio, aliisque nonnullis, qui constitutionis et habitus corporis admodum sicci fuerunt, quod acutissimis febribus correpti ita incaluerint, ut manum admotam aliquantulum urere visi sint.

9. Animalia, ex motu et exercitatione, ex vino et epulis, ex venere, ex febribus ardentibus, et ex dolore, augentur calore.

10. Animalia, in accessibus febrium intermittentium, a principio frigore et horrore corripiuntur; sed paulo post majorem in modum incalescunt; quod etiam faciunt a principio in causonibus, et febribus pestilentialibus.

11. Inquiratur ulterius de calore comparato in diversis animalibus, veluti piscibus, quadrupedibus, serpen-

87 This is probably erroneous; it is not usually thought that putrefaction does more than provide a suitable condition for the life of Animalculæ.

88 Cf. supr. II. 12. Inst. 12.

tibus, avibus; atque etiam secundum species ipsorum, ut in leone, milvio, homine; nam ex vulgari opinione, pisces per interiora minus calidi sunt, aves autem maxime calidæ; præsertim columbæ, accipitres, struthiones.

12. Inquiratur ulterius de calore comparato in eodem animali secundum partes et membra ejus diversa. Nam lac, sanguis, sperma, ova, inveniuntur gradu modico tepida, et minus calida quam ipsa caro exterior in animali, quando movetur, aut agitatur. Qualis vero gradus sit caloris in cerebro, stomacho, corde, et reliquis, similiter adhuc non est quæsitum.

13. Animalia omnia, per hyemem et tempestates frigidas, secundum exterius frigent; sed per interiora etiam magis esse calida existimantur.

14. Calor cœlestium etiam in regione calidissima, atque temporibus anni et diei calidissimis, non eum gradum caloris obtinet, qui vel lignum aridissimum, vel stramen, vel etiam linteum ustum incendat aut adurat, nisi per specula comburentia roboretur; sed tamen e rebus humidis vaporem excitare potest.

15. Ex traditione astronomorum ponuntur stellæ aliæ magis, aliæ minus calidæ. Inter planetas enim post Solem ponitur Mars calidissimus; deinde Jupiter, deinde Venus; ponuntur autem tanquam frigidi, Luna, et deinde omnium maxime Saturnus. Inter fixas autem ponitur calidissimus Sirius; deinde Cor leonis, sive Regulus; deinde Canicula, &c[89].

16. Sol magis calefacit, quo magis vergit ad perpendiculum, sive zenith[90]; quod etiam credendum est

[89] This is entirely based on error. Cf. supra, II. 12. Inst. 1.
[90] See supra, II. 12. Inst. 3.

de aliis planetis, pro modulo suo caloris; exempli gratia, Jovem magis apud nos calefacere, cum positus sit sub Cancro, aut Leone, quam sub Capricorno, aut Aquario.

17. Credendum est, solem ipsum, et planetas reliquos, magis calefacere in perigæis suis, propter propinquitatem ad terram, quam in apogæis[91]. Quod si eveniat, ut in aliqua regione sol sit simul in perigæo, et propius ad perpendiculum; necesse est, ut magis calefaciat, quam in regione ubi sol sit similiter in perigæo, sed magis ad obliquum. Adeo ut comparatio exaltationis planetarum notari debeat, prout ex perpendiculo aut obliquitate participet, secundum regionum varietatem.

18. Sol etiam, et similiter reliqui planetæ, calefacere magis existimantur, cum sint in proximo ad stellas fixas majores; veluti cum sol ponitur in Leone, magis vicinus fit Cordi Leonis, Caudæ Leonis, et Spicæ Virginis, et Sirio, et Caniculæ, quam cum ponitur in Cancro, ubi tamen magis sistitur ad perpendiculum[92]. Atque credendum est, partes cœli majorem infundere calorem (licet ad tactum minime perceptibilem) quo magis ornatæ sint stellis, præsertim majoribus.

19. Omnino calor cœlestium augetur tribus modis; videlicet ex perpendiculo, ex propinquitate sive perigæo, et ex conjunctione sive consortio stellarum.

20. Magnum omnino invenitur intervallum inter calo-

[91] This is true enough in itself: but as the sun, when in Perigee, is "magis ad obliquum," we happen to have the coldest weather when the Sun is nearest the earth.

[92] Cf. supra, II. 12. Inst. 1. The explanation of course is, that the Earth's Heat reaches its Maximum about August; just as about 2 o'clock P.M. is the hottest time of the day.

rem animalium, ac etiam radiorum cœlestium, (prout ad nos deferuntur) atque flammam, licet lenissimam, atque etiam ignita omnia, atque insuper liquores, aut aërem ipsum, majorem in modum ab igne calefactum. Etenim flamma spiritus vini, præsertim rara, nec constipata, tamen potis est stramen, aut linteum, aut papyrum incendere; quod nunquam faciet calor animalis, vel solis, absque speculis comburentibus[93].

21. Flammæ autem et ignitorum plurimi sunt gradus in fortitudine et debilitate caloris[94]. Verum de his nulla est facta diligens inquisitio; ut necesse sit ista leviter transmittere. Videtur autem ex flammis illa ex spiritu vini esse mollissima; nisi forte ignis fatuus, aut flammæ, seu coruscationes ex sudoribus animalium, sint molliores. Hanc sequi opinamur flammam ex vegetabilibus levibus et porosis, ut stramine, scirpis, et foliis arefactis; a quibus non multum differre flammam ex pilis aut plumis. Hanc sequitur fortasse flamma ex lignis, præsertim iis, quæ non multum habent ex resina aut pice; ita tamen ut flamma ex lignis quæ parva sunt mole (quæ vulgo colligantur in fasciculos) lenior sit, quam quæ fit ex truncis arborum et radicibus. Id quod vulgo experiri licet in fornacibus, quæ ferrum excoquunt; in quibus ignis ex fasciculis et ramis arborum non est admodum utilis. Hanc sequitur (ut arbitramur) flamma ex oleo, et sevo, et cera, et hujusmodi oleosis et pinguibus,

93 Flame kindles combustibles more readily than many bodies do whose Heat is far greater, because it is in a condition which enables it to combine easily with the inflammable chemical elements of bodies.

94 The intensity of Heat of flame in different substances depends on the composition of the body burning, and on its readiness to combine with the Oxygen of the atmosphere.

quæ sunt sine magna acrimonia. Fortissimus autem calor reperitur in pice et resina, atque adhuc magis in sulphure, et caphura, et naphtha, et petroleo, et salibus, (postquam materia cruda eruperit) et in horum compositionibus, veluti pulvere tormentario, igne Græco[95], (quem vulgo ignem ferum vocant) et diversis ejus generibus, quæ tam obstinatum habent calorem, ut ab aquis non facile exstinguantur.

22. Existimamus etiam flammam, quæ resultat ex nonnullis metallis imperfectis[96], esse valde robustam et acrem. Verum de istis omnibus inquiratur ulterius.

23. Videtur autem flamma fulminum potentiorum[97] has omnes flammas superare; adeo ut ferrum ipsum perfectum aliquando colliquaverit in guttas; quod flammæ illæ alteræ facere non possunt.

24. In ignitis autem diversi sunt etiam gradus caloris, de quibus etiam non facta est diligens inquisitio. Calorem maxime debilem existimamus esse ex linteo usto; quali ad flammæ excitationem uti solemus; et similiter ex ligno illo spongioso, aut funiculis arefactis, qui ad tormentorum accensionem adhibentur. Post hunc sequitur carbo ignitus ex lignis, et anthracibus, atque etiam ex lateribus ignitis, et similibus. Ignitorum autem vehementissime calida existimamus esse metalla ignita, ut

[95] Gunpowder. The ordinary composition of Gunpowder is $\frac{5}{7}$ nitre, $\frac{1}{7}$ sulphur, $\frac{1}{7}$ charcoal. See infr. II. 36. Inst. 7.

Greek-fire was said to be composed of sulphur, naphtha, pitch, gum, and bitumen; it burnt under water. It was invented by a Greek engineer of Heliopolis in Syria, named Callinicus, A. D. 660.

[96] "Imperfect Metals," sc. those metallic substances which are ductile and fixed in the fire, *to a certain degree*, but which are destroyed by the continued action of fire; i. e. changed into an earth deprived of all the characteristic properties of metals—viz. copper, iron, tin, and lead.

[97] "potentiorum," as opposed to Sheet lightning. Cf. supra, II. 12. Inst. 9.

ferrum, et cuprum, et cætera. Verum de his etiam facienda est ulterior inquisitio.

25. Inveniuntur ex ignitis nonnulla longe calidiora, quam nonnullæ ex flammis. Multo enim calidius est et magis adurens ferrum ignitum, quam flamma spiritus vini.

26. Inveniuntur etiam ex illis, quæ ignita non sunt, sed tantum ab igne calefacta, sicut aquæ ferventes, et aër conclusus in reverberatoriis, nonnulla, quæ superant calore multa ex flammis ipsis et ignitis.

27. Motus auget calorem[98]; ut videre est in follibus et flatu; adeo ut duriora ex metallis non solvantur aut liquefiant per ignem mortuum aut quietum, nisi flatu excitetur.

28. Fiat experimentum per specula comburentia, in quibus (ut memini) hoc fit; ut si speculum ponatur (exempli gratia) ad distantiam spithamæ ab objecto combustibili, non tantopere incendat aut adurat, quam si positum fuerit speculum (exempli gratia) ad distantiam semispithamæ, et gradatim et lente trahatur ad distantiam spithamæ. Conus tamen et unio radiorum eadem sunt, sed ipse motus auget operationem caloris[99].

29. Existimantur incendia illa, quæ fiunt flante vento forti, majores progressus facere adversus ventum, quam secundum ventum; quia scilicet flamma resilit motu perniciore, vento remittente, quam procedit, vento impellente[100].

[98] By supplying a greater quantity of Oxygen from the Air. It is not mere motion, for the manufacturer who tried to blow his fires by means of steam jets, simply blew them out.

[99] There is no foundation in fact for this. The latter process would perhaps enable us to find the exact focus better, and so might cause a stronger Heat.

[100] This is not the case. The brightness of fire, when exposed to a high wind, is accounted for by note 98.

30. Flamma non emicat aut generatur, nisi detur aliquid concavi, in quo flamma movere possit et ludere; præterquam in flammis flatuosis pulveris tormentarii, et similibus, ubi compressio et incarceratio flammæ auget ejus furorem[1].

31. Incus per malleum calefit admodum; adeo ut si incus fuerit laminæ tenuioris, existimemus illam per fortes et continuos ictus mallei posse rubescere, ut ferrum ignitum; sed de hoc fiat experimentum[2].

32. At in ignitis, quæ sunt porosa, ita ut detur spatium ad exercendum motum ignis, si cohibeatur hujusmodi motus per compressionem fortem, statim exstinguitur ignis; veluti cum linteum ustum, aut filum ardens candelæ aut lampadis, aut etiam carbo aut pruna ardens, comprimitur per pressorium, aut pedis conculcationem, aut hujusmodi, statim cessant operationes ignis.

33. Approximatio ad corpus calidum auget calorem, pro gradu approximationis; quod etiam fit in lumine: nam quo propius collocatur objectum ad lumen, eo magis est visibile[3].

34. Unio calorum diversorum auget calorem, nisi facta sit commistio corporum. Nam focus magnus, et

[1] Common flame requires Oxygen, and therefore requires *room*, i.e. air. The case of Gunpowder is not the same, as there the explosion arises from other causes: the "incarceratio" only gives direction to the explosive power. The actual expansion would be just the same in the open air.

[2] "Condensation, whether of air by pressure, or of metals by percussion, is a powerful source of Heat. Thus, iron may be so dexterously hammered as to be red-hot." Herschel's Discourse, § 347.

[3] "The Laws of the Radiation of Heat have been found to present strong analogies with those of Light in some points, and singular differences in others." They have been investigated by M. Prevost, and by M. M. Dulong and Petit. As we approach the radiating body (whether it be luminous or hot), we perceive a greater intensity of Light or Heat, and vice versa. See Herschel's Discourse, § 351.

focus parvus in eodem loco, nonnihil invicem augent calorem; at aqua tepida immissa in aquam ferventem refrigerat[4].

35. Mora corporis calidi auget calorem. Etenim calor perpetuo transiens et emanans commiscetur cum calore præinexistente, adeo ut multiplicet calorem. Nam focus non æque calefacit cubiculum per moram semihoræ, ac si idem focus duret per horam integram. At hoc non facit lumen; etenim lampas aut candela, in aliquo loco posita, non magis illuminat per moram diuturnam, quam statim ab initio[5].

36. Irritatio per frigidum ambiens auget calorem; ut in focis videre est per gelu acre[6]. Quod existimamus fieri non tantum per conclusionem et contractionem caloris, quæ est species unionis; sed per exasperationem: veluti cum aër aut baculum violenter comprimitur aut flectitur, non ad punctum loci prioris resilit, sed ulterius in contrarium. Itaque fiat diligens experimentum, per baculum vel simile aliquid immissum in flammam, utrum ad latera flammæ non uratur citius, quam in medio flammæ.

37. Gradus autem in susceptione caloris sunt complu-

[4] Flames consuming Oxygen recombine their strength: water, not consuming it, but being heated by other means, and having no proper heat, when mixed at two different temperatures, on combination, takes a mean temperature between the two. The Heat follows the Law which leads it to tend towards an equilibrium.

[5] Light does not seem to penetrate the air as Heat does. There is no steady augmentation of light in a room, as there is of Heat. Air accepts Heat very slowly, and retains it readily, and so, after removing the source of Heat the effect is felt for some time; whereas on removing a candle, the light dies out almost instantaneously.

[6] In dry frosty weather the Oxygen is more readily detached from the air, and also the draught of air is quicker. Also the edges of flame are the hottest, because of their contact with the Air which feeds.

res. Atque primo omnium notandum est, quam parvus et exilis calor etiam ea corpora, quæ caloris minime omnium sunt susceptiva, immutet tamen et nonnihil calefaciat. Nam ipse calor manus globulum plumbi, aut alicujus metalli, paulisper detentum nonnihil calefacit. Adeo facile, et in omnibus, transmittitur et excitatur calor, corpore nullo modo ad apparentiam immutato.

38. Facillime omnium corporum apud nos et excipit et remittit calorem aër[7]; quod optime cernitur in vitris calendaribus[8]. Eorum confectio est talis; accipiatur vitrum ventre concavo, collo tenui et oblongo; resupinetur, et demittatur hujusmodi vitrum, ore deorsum verso, ventre sursum, in aliud vasculum vitreum ubi sit aqua, tangendo fundum vasculi illius recipientis, extremo ore vitri immissi; et incumbat paululum vitri immissi collum ad os vitri recipientis, ita ut stare possit; quod ut commodius fiat, apponatur parum ceræ ad os vitri recipientis, ita tamen ut non penitus obturetur os ejus, ne ob defectum aëris succedentis impediatur motus, de quo jam dicetur, qui est admodum facilis et delicatus.

Oportet autem ut vitrum demissum, antequam inseratur in alterum, calefiat ad ignem a parte superiori, ventre scilicet. Postquam autem fuerit vitrum illud collocatum, ut diximus, recipiet et contrahet se aër (qui dilatatus erat per calefactio-

[7] Erroneous. Cf. supra, note 5, and II. 12. Inst. 18.

[8] Cf. Herschel's Discourse, § 356. "The Thermometer, as originally constructed by Cornelius Drebell, was an Air Thermometer. Those now in use measure accessions of Heat, not by the degree of dilatation of Air, but of Mercury. Newton has the credit of having been the first to graduate the Thermometer." This last remark is surely wrong; for Bacon below expressly says "Debet appendi charta angusta et oblonga, et *gradibus* (quot libuerit) interstincta."

nem) post moram sufficientem pro extinctione illius ascititii caloris, ad talem extensionem sive dimensionem, qualis erit aëris ambientis aut communis tunc temporis, quando immittitur vitrum; atque attrahet aquam in sursum ad hujusmodi mensuram. Debet autem appendi charta angusta et oblonga, et gradibus (quot libuerit) interstincta. Videbis autem, prout tempestas diei incalescit aut frigescit, aërem se contrahere in angustius per frigidum, et extendere se in latius per calidum; id quod conspicietur per aquam ascendentem quando contrahitur aër, et descendentem sive depressam quando dilatatur aër. Sensus autem aëris, quatenus ad calidum et frigidum, tam subtilis est et exquisitus, ut facultatem tactus humani multum superet; adeo ut solis radius aliquis, aut calor anhelitus, multo magis calor manus, super vitri summitatem positus, statim deprimat aquam manifesto. Attamen existimamus, spiritum animalium magis adhuc exquisitum sensum habere calidi et frigidi, nisi quod a mole corporea impediatur et hebetetur.

39. Post aërem existimamus corpora esse maxime sensitiva caloris ea, quæ a frigore recenter immutata sint et compressa, qualia sunt nix, et glacies; ea enim leni aliquo tepore solvi incipiunt et colliquari. Post illa sequitur fortasse argentum vivum. Post illud sequuntur corpora pinguia, ut oleum, butyrum, et similia; deinde lignum; deinde aqua. Postremo lapides, et metalla, quæ non facile calefiunt, præsertim interius. Illa tamen calorem semel susceptum diutissime retinent; ita ut later, aut lapis, aut ferrum ignitum, in pelvim aquæ frigidæ immissum et demersum, per quartam partem horæ

(plus minus) retineat calorem, ita ut tangi non possit[9].

40. Quo minor est corporis moles, eo citius per corpus calidum approximatum incalescit; id quod demonstrat omnem calorem apud nos esse corpori tangibili quodammodo adversum[10].

41. Calidum, quatenus ad sensum et tactum humanum, res varia est et respectiva: adeo ut aqua tepida, si manus frigore occupetur, sentiatur esse calida; sin manus incaluerit, frigida.

XIV.

Quam inopes simus historiæ, quivis facile advertet, cum in *tabulis* superioribus, præterquam quod loco historiæ probatæ et instantiarum certarum nonnunquam traditiones et relationes inseramus, (semper tamen adjecta dubiæ fidei et auctoritatis nota) sæpenumero etiam hisce verbis, *Fiat experimentum*, vel *Inquiratur ulterius*, uti cogamur[11].

XV.

Atque opus et officium harum trium tabularum *Comparentiam instantiarum ad intellectum* vocare consuevimus. Facta autem *comparentia*, in opere ponenda est ipsa *inductio*. Invenienda est enim, super *comparentiam* omnium et singularum instantiarum, natura talis, quæ cum natura data perpetuo adsit, absit; atque crescat, et decrescat; sitque (ut superius dictum est) limitatio naturæ magis communis[12]. Hoc si mens jam

[9] All this of course is accounted for by the greater density of stones and metals.

[10] Wrong again for the same reason. Solid bodies are the best conductors of Heat; and the longer time which bodies of greater mass take in growing hot, arises entirely from the greater density; i.e. from the number of particles to be heated.

[11] The constant correction which Bacon's Tables require needs but little apology; and they who are hard upon him might well recollect this Aphorism.

[12] Cf. supr. II.4, &c. Appendix E.

ab initio facere tentet affirmative[13], (quod sibi permissa semper facere solet) occurrent phantasmata, et opinabilia, et notionalia male terminata, et axiomata quotidie emendanda; nisi libeat (scholarum more) pugnare pro falsis[14]. Ea tamen proculdubio erunt meliora aut praviora, pro facultate et robore intellectus qui operatur. At omnino Deo (formarum inditori et opifici[15]) aut fortasse angelis et intelligentiis competit, formas per affirmationem immediate nosse, atque ab initio contemplationis. Sed certe supra hominem est; cui tantum conceditur, procedere primo per *negativas*, et postremo loco desinere in *affirmativas*, post omnimodam exclusionem.

XVI.

Itaque naturæ facienda est prorsus solutio et separatio; non per ignem certe, sed per mentem, tanquam ignem divinum. Est itaque *inductionis* veræ opus primum (quatenus ad inveniendas formas) *rejectio* sive *exclusiva* naturarum singularum, quæ non inveniuntur in aliqua instantia, ubi natura data adest; aut inveniuntur in aliqua instantia, ubi natura data abest; aut inveniuntur in aliqua instantia crescere, cum natura data decrescat; aut decrescere, cum natura data crescat. Tum vero post *rejectionem* et *exclusivam* debitis modis factam, secundo loco (tanquam in fundo) manebit (abeun-

[13] Cf. supr. I. 46.

[14] *θέσιν διαφυλάττειν*—as an Intellectual exercise, not as in search after Truth. Bacon would only regard Mental training as in connection with Truth. "Scholarum more" may here mean places of education, as the "Schools" of the Universities. We retain relics of this principle of disputation in the Divinity exercises at Oxford.

[15] This looks quite Platonic—"intelligentiis," the Scholastic name for beings of higher order than man, who know instinctively, it may be; and not by means of processes. The necessity for *negative* investigation is a sign of the feebleness of Man's Intellect.

This also corresponds to some degree with the Aristotelian doctrine that the happiness of all above Man is contemplative.

tibus in fumum opinionibus volatilibus) forma affirmativa, solida, et vera, et bene terminata. Atque hoc breve dictu est, sed per multas ambages ad hoc pervenitur. Nos autem nihil fortasse de iis, quæ ad hoc faciunt, prætermittemus.

XVII.

Cavendum autem est, et monendum quasi perpetuo, ne, cum tantæ partes formis videantur a nobis tribui, trahantur ea, quæ dicimus, ad formas eas, quibus hominum contemplationes et cogitationes hactenus assueverunt.

Primo enim, de formis copulatis[16], quæ sunt (ut diximus) naturarum simplicium conjugia ex cursu communi universi, ut leonis, aquilæ, rosæ, auri, et hujusmodi, impræsentiarum non loquimur. Tempus enim erit de iis tractandi, cum ventum fuerit ad *latentes processus*, et *latentes schematismos*, eorumque inventionem, prout reperiuntur in substantiis (quas vocant) seu naturis concretis.

Rursus vero, non intelligantur ea, quæ dicimus (etiam quatenus ad naturas simplices) de formis et ideis abstractis, aut in materia non determinatis, aut male determinatis[17]. Nos enim quum de formis loquimur, nil aliud intelligimus, quam leges illas et deter-

[16] Two uses of the Term *Form* are rejected. (1) *Formæ copulatæ*, simply (it would seem) combinations in an unnatural manner of individuals belonging to different classes. Classes keep to themselves naturally: if they transgress, the result is a "Lusus Naturæ" of some kind. (2) *Formæ et Ideæ abstractæ*. The Platonic *εἴδη χωριστὰ*, as Aristotle termed them. For all this Aphorism, see Appendix E. The "ut diximus" refers to II. 5.

[17] The Platonic Forms. Bacon uses similar language to this in the De Augm. III. iv. "Manifestum est, Platonem, virum sublimis ingenii (quique velut ex rupe excelsa omnia circumspiciebat), in sua de Ideis doctrina, Formas esse verum scientiæ objectum vidisse; utcunque sententiæ hujus verissimæ fructum amiserit, formas penitus a materia abstractas, non in materia determinatas, contemplando et prensando."

minationes actus puri, quæ naturam aliquam simplicem ordinant et constituunt; ut calorem, lumen, pondus, in omnimoda materia et subjecto susceptibili. Itaque eadem res est forma calidi, aut forma luminis, et lex calidi sive lex luminis; neque vero a rebus ipsis et parte operativa unquam nos abstrahimus, aut recedimus. Quare cum dicimus (exempli gratia) in inquisitione formæ caloris, *Rejice tenuitatem*, aut *Tenuitas non est ex forma caloris;* idem est ac si dicamus, *Potest homo superinducere calorem in corpus densum;* aut contra, *Potest homo auferre aut arcere calorem a corpore tenui.*

Quod si cuiquam videantur etiam formæ nostræ habere nonnihil abstracti, quod misceant et conjungant heterogenea, (videntur enim valde esse heterogenea calor cœlestium, et ignis; rubor fixus in rosa, aut similibus, et apparens in iride, aut radiis opalii, aut adamantis; mors ex summersione, ex crematione, ex punctura gladii, ex apoplexia, ex atrophia; et tamen conveniunt ista in natura calidi, ruboris, mortis) is se habere intellectum norit consuetudine et integralitate rerum et opinionibus captum et detentum. Certissimum enim est, ista, utcunque heterogenea et aliena, coire in formam, sive legem eam, quæ ordinat calorem, aut ruborem, aut mortem; nec emancipari posse potentiam humanam, et liberari a naturæ cursu communi, et expandi et exaltari ad efficientia nova, et modos operandi novos, nisi per revelationem et inventionem hujusmodi formarum; et tamen post istam unionem naturæ[18], quæ est res maxime principalis, de naturæ divisionibus et venis, tam ordinariis, quam interioribus et verioribus, suo loco postea dicetur.

[18] I. e. the common Form or principle of Nature found in Heterogeneous Natures. Cf. supr. II. 3.

XVIII.

Jam vero proponendum est exemplum *exclusionis* sive *rejectionis* naturarum [19], quæ per *tabulas comparentiæ* reperiuntur non esse ex forma calidi; illud interim monendo, non solum sufficere singulas *tabulas* ad *rejectionem* alicujus naturæ, sed etiam unamquamque ex instantiis singularibus in illis contentis. Manifestum enim est ex iis, quæ dicta sunt, omnem *instantiam contradictoriam* destruere opinabile de forma. Sed nihilominus quandoque perspicuitatis causa, et ut usus *tabularum* clarius demonstretur, *exclusivam* duplicamus, aut repetimus.

Exemplum *exclusivæ*, sive *rejectionis naturarum* a forma calidi.

1. Per radios solis, *rejice* naturam elementarem [20].
2. Per iguem communem, et maxime per ignes subterraneos (qui remotissimi sunt, et plurimum intercluduntur a radiis cœlestibus) *rejice* naturam cœlestem.
3. Per calefactionem omnigenum corporum (hoc est, mineralium, vegetabilium, partium exteriorum animalium, aquæ, olei, aëris, et reliquorum) ex approximatione sola ad ignem aut aliud corpus calidum; *rejice* omnem varietatem, sive subtiliorem texturam corporum.
4. Per ferrum et metalla ignita, quæ calefaciunt alia corpora, nec tamen omnino pondere aut substantia minuuntur; *rejice* inditionem sive mixturam substantiæ alterius calidi.
5. Per aquam ferventem, atque aërem, atque etiam

[19] Carrying out the principle of operation laid down in II. 16.

[20] Such a nature as would come under one of the four Elements. It is usually translated "Terrestrial."

per metalla, et alia solida calefacta, sed non usque ad ignitionem sive ruborem; *rejice* lucem et lumen[21].

6. Per radios lunæ, et aliarum stellarum, (excepto sole) *rejice* etiam lucem et lumen.
7. Per *comparativam* ferri igniti, et flammæ spiritus vini, (ex quibus ferrum ignitum plus habet calidi et minus lucidi, flamma autem spiritus vini plus lucidi et minus calidi) *rejice* etiam lucem et lumen.
8. Per aurum et alia metalla ignita, quæ densissimi sunt corporis secundum totum[22]; *rejice* tenuitatem.
9. Per aërem, qui invenitur ut plurimum frigidus, et tamen manet tenuis; *rejice* etiam tenuitatem.
10. Per ferrum ignitum, quod non intumescit mole[23], sed manet intra eandem dimensionem visibilem; *rejice* motum localem, aut expansivum, secundum totum.
11. Per dilatationem aëris in vitris calendariis et similibus, qui movetur localiter et expansive manifesto, neque tamen colligit manifestum augmentum caloris; *rejice* etiam motum localem, aut expansivum secundum totum.
12. Per facilem tepefactionem omnium corporum, absque aliqua destructione aut alteratione notabili; *rejice* naturam destructivam, aut inditionem violentam alicujus naturæ novæ.
13. Per consensum et conformitatem operum similium, quæ eduntur a calore et a frigore; *rejice* motum tam expansivum quam contractivum, secundum totum.

[21] *lux* and *lumen*. "*Lux*, id quod lumine diffunditur, claritas, fulgor; *Lumen*, id quod splendorem diffundit." Döderlein, ii. 66.

[22] Cf. supr. II. 12. Inst. 22.

[23] Erroneous. Iron expands under Heat.

14. Per accensionem caloris ex attritione corporum; *rejice* naturam principalem. Naturam principalem vocamus eam, quæ positiva reperitur in natura, nec causatur a natura præcedente.

Sunt et aliæ naturæ: neque enim tabulas conficimus perfectas, sed exempla tantum.

Omnes et singulæ naturæ prædictæ non sunt ex forma calidi. Atque ab omnibus naturis prædictis liberatur homo in operatione super calidum.

XIX.

Atque in *exclusiva* jacta sunt fundamenta *inductionis* veræ, quæ tamen non perficitur donec sistatur in affirmativa. Neque vero ipsa *exclusiva* ullo modo perfecta est, neque adeo esse potest sub initiis. Est enim *exclusiva* (ut plane liquet) *rejectio* naturarum simplicium. Quod si non habeamus adhuc bonas et veras notiones naturarum simplicium, quomodo rectificari potest *exclusiva?* At nonnullæ ex supradictis (veluti notio naturæ elementaris, notio naturæ cœlestis, notio tenuitatis) sunt notiones vagæ, nec bene terminatæ. Itaque nos, qui nec ignari sumus, nec obliti, quantum opus aggrediamur, (viz. ut faciamus intellectum humanum rebus et naturæ parem) nullo modo acquiescimus in his, quæ adhuc præcepimus: sed et rem in ulterius provehimus, et fortiora auxilia in usum intellectus machinamur et ministramus; quæ nunc subjungemus. Et certe in *interpretatione naturæ* animus omnino taliter est præparandus et formandus, ut et sustineat se in gradibus debitis certitudinis, et tamen cogitet (præsertim sub initiis) ea, quæ adsunt, multum pendere ex iis, quæ supersunt.

XX.

Attamen quia citius emergit[24] veritas ex errore quam

[24] Not always. The progress in a wrong and a definite line is more

ex confusione, utile putamus, ut fiat permissio intellectui, post tres tabulas *comparentiæ primæ* (quales posuimus) factas et pensitatas, accingendi se et tentandi opus *interpretationis naturæ* in affirmativa; tam ex instantiis tabularum, quam ex iis, quæ alias occurrent. Quod genus tentamenti, *permissionem intellectus*, sive *interpretationem inchoatam*, sive *vindemiationem primam*[25] appellare consuevimus.

Vindemiatio prima de forma calidi.

Animadvertendum autem est, formam rei inesse (ut ex iis, quæ dicta sunt, plane liquet) instantiis universis et singulis, in quibus res ipsa inest; aliter enim forma non esset: itaque nulla plane dari potest *instantia* contradictoria. Attamen longe magis conspicua invenitur forma et evidens in aliquibus *instantiis*, quam in aliis; in iis videlicet, ubi minus cohibita est natura formæ, et impedita, et redacta in ordinem, per naturas alias. Hujusmodi autem instantias, *elucescentias* vel *instantias ostensivas* appellare consuevimus[26]. Pergendum itaque est ad *vindemiationem* ipsam *primam* de forma calidi.

Per universas et singulas *instantias*, natura, cujus limitatio est calor, videtur esse motus. Hoc autem

harmful than no progress at all; and definite error is often more tenacious than indefinite.

[25] This phrase, "Vindemiatio *prima*," shews that Bacon does not think he has settled the subject of Heat, or has arrived at its Form. All the other Auxilia (cf. infr. II. 21) are yet to be brought to bear upon it. For after all, "Limited Motion" is by no means a Physical Form, if one rightly understands Bacon's meaning; but at the best a substitution only "notionis magis noscibilis." Bacon's "Motus" may possibly be right, though the Instances by which he reaches it are wrong. At present the judgment of the Authorities on Physical subjects inclines to the contrary view; viz. that Heat is a very subtle material substance, not a mere motion in other substances. See infr. note 38.

[26] Cf. infr. II. 24.

maxime ostenditur in flamma, quæ perpetuo movetur; et in liquoribus ferventibus aut bullientibus, qui etiam perpetuo moventur. Atque ostenditur etiam in incitatione sive incremento caloris facto per motum; ut in follibus, et ventis: de quo vide *Instant.* 29. *Tab.* 3. Atque similiter in aliis modis motus, de quibus vide *Instant.* 28. *et* 31. *Tab.* 3. Rursus ostenditur in extinctione ignis et caloris per omnem fortem compressionem, quæ frænat et cessare facit motum: de qua vide *Instant.* 30. *et* 32. *Tab.* 3. Ostenditur etiam in hoc, quod omne corpus destruitur, aut saltem insigniter alteratur, ab omni igne et calore forti ac vehementi. Unde liquido constat, fieri a calore tumultum et perturbationem, et motum acrem, in partibus internis corporis; qui sensim vergit, ad dissolutionem.

Intelligatur hoc, quod diximus de motu, (nempe, ut sit instar generis ad calorem) non quod calor generet motum, aut quod motus generet calorem, (licet et hæc in aliquibus vera sint) sed quod ipsissimus calor, sive *quid ipsum*[27] caloris sit motus, et nihil aliud: limitatus tamen per *differentias*, quas mox subjungemus, postquam nonnullas cautiones adjecerimus ad evitandum æquivocum.

Calidum ad sensum, res respectiva est, et in ordine ad hominem, non ad universum: et ponitur recte ut effectus caloris tantum in spiritum animalem[28]: quinetiam in se ipso res varia est, cum idem corpus (prout sensus prædisponitur) inducat perceptionem tam calidi quam frigidi: ut patet per *Instant.* 41. *Tab.* 3.

Neque vero communicatio caloris, sive natura ejus

[27] "*Ipsissimus* Calor sive *quid ipsum* Caloris"—essential Heat, or τὸ τί ἦν εἶναι of Heat. That which makes it what it is. This looks as if Bacon believed that he had really reached the Form.

[28] For note on *Spiritus Animalis*, see infr. II. 27.

transitiva, per quam corpus admotum corpori calido incalescit, confundi debet cum forma calidi[29]. Aliud enim est calidum, aliud calefactivum. Nam per motum attritionis inducitur calor absque aliquo calido præcedente, unde excluditur calefactivum a forma calidi. Atque etiam ubi calidum efficitur per approximationem calidi, hoc ipsum non fit ex forma calidi; sed omnino pendet a natura altiore et magis communi; viz. ex natura assimilationis sive multiplicationis sui: de qua facienda est separatim inquisitio.

At notio ignis plebeia est, et nihil valet: composita enim est ex concursu qui fit calidi et lucidi in aliquo corpore; ut in flamma communi, et corporibus accensis usque ad ruborem.

Remoto itaque omni æquivoco, veniendum jam tandem est ad *differentias* veras, quæ limitant motum, et constituunt eum in formam calidi.

Prima igitur *differentia* ea est, quod calor sit motus expansivus[30], per quem corpus nititur ad dilatationem sui, et recipiendum se in majorem sphæram sive dimensionem, quam prius occupaverat. Hæc autem *differentia* maxime ostenditur in flamma; ubi fumus sive halitus pinguis manifesto dilatatur et aperit se in flammam.

Ostenditur etiam in omni liquore fervente, qui

[29] Right. Cf. Herschel's Discourse, § 345. The communication of Heat, (which results from the Law of Heat, whereby it always endeavours to cause an equilibrium of temperature) is entirely distinct from Heat itself.

[30] It would seem hard to reconcile this with the 10th Rejection in the IVth Table (cf. supr. II. 18. Inst. 10); nor does the distinction of "secundum totum" throw much light on it. See Limitation 3. The fact however is correct. The dilatation of bodies by Heat forms the subject of that separate branch of Science which is termed Pyrometry.

manifesto intumescit, insurgit, et emittit bullas, atque urget processum expandendi se, donec vertatur in corpus longe magis extensum et dilatatum, quam sit ipse liquor: viz. in vaporem, aut fumum, aut aërem.

Ostenditur etiam in omni ligno et combustibili; ubi fit aliquando exsudatio, at semper evaporatio.

Ostenditur etiam in colliquatione metallorum; quæ (cum sint corporis compactissimi) non facile intumescunt et se dilatant: sed tamen spiritus eorum, postquam fuerit in se dilatatus, et majorem adeo dilatationem concupierit, trudit plane et agit partes crassiores in liquidum. Quod si etiam calor fortius intendatur, solvit et vertit multum ex iis in volatile.

Ostenditur etiam in ferro aut lapidibus: quæ licet non liquefiant aut fundantur, tamen emolliuntur[31]. Quod etiam fit in baculis ligni, quæ calefacta paululum in cineribus calidis fiunt flexibilia.

Optime autem cernitur iste motus in aëre, qui per exiguum calorem se dilatat continuo et manifesto, ut per *Instant.* 38. *Tab.* 3.

Ostenditur etiam in natura contraria frigidi[32]. Frigus enim omne corpus contrahit et cogit in angustius; adeo ut per intensa frigora clavi excidant ex parietibus, æra dissiliant, vitrum etiam calefactum

[31] Bacon here seems to contemplate the possibility of Iron, and some kinds of Stone, not melting. "There is no solid substance known, which, by a sufficiently intense Heat, may not be melted, and finally dissipated in vapour." Herschel's Discourse, § 357.

[32] Cold is here regarded as a separate and distinct Nature. It is not actually true that "frigus omne corpus contrahit." The contrary is the case with Ice. The French popular way of speaking of "degrees of Cold," (arising from their use of Réaumur's Thermometer, so graduated that the freezing point is zero,) tends to keep up this false notion of absolute Cold.

et subito positum in frigido dissiliat et frangatur. Similiter aër per levem infrigidationem recipit se in angustius: ut per *Instant.* 38. *Tab.* 3. Verum de his fusius dicetur in inquisitione de frigido.

Neque mirum est, si calidum et frigidum edant complures actiones communes, (de quo vide *Instant.* 32. *Tab.* 2.) cum inveniantur duæ ex sequentibus *differentiis*, (de quibus mox dicemus) quæ competunt utrique naturæ; licet in hac *differentia* (de qua nunc loquimur) actiones sint ex diametro oppositæ: calidum enim dat motum expansivum et dilatantem, frigidum autem dat motum contractivum et coëuntem.

Secunda differentia est modificatio prioris; hæc videlicet, quod calor sit motus expansivus, sive versus circumferentiam: hac lege tamen, ut una feratur corpus sursum [33]. Dubium enim non est, quin sint motus complures mixti. Exempli gratia: sagitta aut spiculum simul et progrediendo rotat, et rotando progreditur. Similiter et motus caloris simul est et expansivus, et latio in sursum.

Hæc vero *differentia* ostenditur in forcipe, aut bacillo ferreo immisso in ignem: quia si immittatur perpendiculariter, tenendo manum superius, cito manum adurit; sin ex latere aut inferius, omnino tardius.

Conspicua etiam est in *distillationibus* per descensorium [34]; quibus utuntur homines ad flores delicati-

[33] Heat in itself has no upward tendency; for though heated particles rise, this is merely a consequence of their expansion (i. e. of their occupying more space, relatively to their density, than other particles do).

[34] i. e. fire is lighted above the flowers, and so the Heat descends to them. The ordinary method of distillation is to immerse the substance in a water or sand-bath, and

ores, quorum odores facile evanescunt. Nam hoc reperit industria, ut collocent ignem non subter, sed supra, ut adurat minus. Neque enim flamma tantum vergit sursum, sed etiam omne calidum.

Fiat autem experimentum hujus rei in contraria natura frigidi: viz. utrum frigus non contrahat corpus descendendo deorsum; quemadmodum calidum dilatat corpus ascendendo sursum. Itaque adhibeantur duo bacilla ferrea, vel duo tubi vitrei, quoad cætera pares; et calefiant nonnihil; et ponatur spongia cum aqua frigida, vel nix, subter unam, et similiter super alteram. Existimamus enim, celeriorem fore refrigerationem ad extremitates in eo bacillo ubi nix ponitur supra, quam in eo ubi nix ponitur subter: contra ac fit in calido.

Tertia differentia ea est; ut calor sit motus, non expansivus uniformiter secundum totum, sed expansivus per particulas minores corporis; et simul cohibitus, et repulsus, et reverberatus; adeo ut induat motum alternativum[35], et perpetuo trepidantem, et tentantem, et nitentem, et ex repercussione irritatum; unde furor ille ignis et caloris ortum habet.

Ista vero *differentia* ostenditur maxime in flamma et liquoribus bullientibus: quæ perpetuo trepidant, et in parvis portionibus tument, et rursus subsidunt.

Ostenditur etiam in iis corporibus, quæ sunt tam duræ compagis, ut calefacta aut ignita non intume-

light fire under it. The reason for this is, that by this means the greatest possible regularity of temperature can be obtained.

[35] This notion of transmission of Waves of Heat, as of light, sound, or colour, is possibly a correct one. But if (as seems almost certain) Heat be regarded as material, the undulatory Theory must be abandoned.

scant aut dilatentur mole; ut ferrum ignitum, in quo calor est acerrimus.

Ostenditur etiam in hoc, quod per frigidissimas tempestates focus ardeat acerrime.

Ostenditur etiam in hoc, quod cum extenditur aër in vitro calendari absque impedimento aut repulsione, uniformiter scilicet et æqualiter; non percipiatur calor. Etiam in ventis conclusis, licet erumpant vi maxima, tamen non percipitur calor insignis; quia scilicet motus fit secundum totum, absque motu alternante in particulis. Atque ad hoc fiat experimentum, utrum flamma non urat acrius versus latera, quam in medio flammæ.

Ostenditur etiam in hoc, quod omnis ustio transigatur per minutos poros corporis, quod uritur; adeo ut ustio subruat, et penetret, et fodicet, et stimulet; perinde ac si essent infinitæ cuspides acus. Itaque ex hoc illud etiam fit, quod omnes aquæ fortes (si proportionatæ sint ad corpus in quod agunt) edant opera ignis, ex natura sua corrodente et pungente.

Atque ista *differentia* (de qua nunc dicimus) communis est cum natura frigidi; in quo cohibetur motus contractivus, per renitentiam expandendi; quemadmodum in calido cohibetur motus expansivus, per renitentiam contrahendi.

Itaque sive partes corporis penetrent versus interius, sive penetrent versus exterius, similis est ratio; licet impar admodum sit fortitudo: quia non habemus hic apud nos in superficie terræ aliquid, quod sit impense frigidum[36]. Vide *Instant.* 27. *Tab.* 1.

[36] Cf. infra, II. 50. § 3, on the want of excessive cold. The means of obtaining cold (or, to speak more correctly, of causing evaporation of Heat) were almost unknown in Bacon's days, and led him to note the want of cold as a defficiency both here and below in II. 50. It is still true that our power of producing Cold is far more limited than that

Quarta differentia est modificatio prioris: hæc scilicet, quod motus ille stimulationis aut penetrationis debeat esse nonnihil rapidus et minime lentus; atque fiat etiam per particulas, licet minutas; tamen non ad extremam subtilitatem, sed quasi majusculas.

Ostenditur hæc *differentia* in comparatione operum quæ edit ignis, cum iis quæ edit tempus sive ætas. Ætas enim sive tempus arefacit, consumit, subruit, et incinerat, non minus quam ignis: vel potius longe subtilius: sed quia motus ejusmodi est lentus admodum, et per particulas valde exiles, non percipitur calor.

Ostenditur etiam in comparatione dissolutionum ferri et auri[37]. Aurum enim dissolvitur absque calore excitato; ferrum autem cum vehementi excitatione caloris, licet simili fere intervallo quoad tempus. Quia scilicet in auro, ingressus aquæ separationis est clemens et subtiliter insinuans, et cessio partium auri facilis: at in ferro, ingressus est asper, et cum conflictu, et partes ferri habent obstinationem majorem.

Ostenditur etiam aliquatenus in gangrænis nonnullis et mortificationibus carnium; quæ non excitant magnum calorem aut dolorem, ob subtilitatem putrefactionis.

Atque hæc sit *prima vindemiatio* sive *interpretatio inchoata* de forma calidi, facta per *permissionem intellectus*.

Ex *vindemiatione* autem ista *prima*, forma sive defi-

of producing Heat. The sudden expansion of gases from a liquid state into vapour is the most powerful source of cold known. Herschel's Discourse, § 354.

[37] These processes (dissolution of Gold by Chemical agencies, and of Iron by Heat of Fire) are not to be thus compared together.

nitio vera caloris (ejus, qui est in ordine ad universum, non relativus tantummodo ad sensum) talis est, brevi verborum complexu. *Calor est motus expansivus, cohibitus, et nitens per partes minores.* Modificatur autem expansio: *ut expandendo in ambitum, nonnihil tamen inclinet versus superiora.* Modificatur autem et nixus ille per partes; *ut non sit omnino segnis, sed incitatus, et cum impetu nonnullo*[38].

Quod vero ad operativam attinet, eadem res est. Nam designatio est talis. *Si in aliquo corpore naturali poteris excitare motum ad se dilatandum, aut expandendum; eumque motum ita reprimere et in se vertere, ut dilatatio illa non procedat æqualiter, sed partim obtineat, partim retrudatur; proculdubio generabis calidum:* non habita ratione, sive corpus illud sit elementare, (ut loquuntur) sive imbutum a cœlestibus[39]; sive luminosum, sive opacum; sive tenue, sive densum; sive localiter expansum, sive intra claustra dimensionis primæ contentum; sive vergens ad dissolutionem, sive

[38] Thus ends Bacon's illustration of his Method. Though we may not use it in modern Induction, still it quite deserves Playfair's encomium: "Bacon's method of treating his collection of facts on the subject of Heat is extremely judicious, and the whole disquisition highly interesting." Encycl. Brit. Dissert. iii. p. 460. At first these 20 Aphorisms seem to have been regarded as the most valuable part of the Novum Organum; and were even printed without the rest of the work at Leyden in 1638. It is, of course, valuable as a full specimen of his Method: by which he hoped "to level intellects," and to obtain a sort of mathematical certainty in discovery. And it is no little praise to be able to add that "his Hypothesis is the very same as one of those which for more than two centuries has divided the opinions of Philosophers. It is still a question whether Heat is really *matter*, or any thing more than *Motion*." The authorities now incline to the former opinion, since Dr. Black's discoveries of Latent Heat.

[39] This is the scholastic distinction between bodies Terrestrial or Elementary and bodies Celestial. As far as modern Astronomy and Chemistry enable us to judge, there is no difference in material between the heavenly bodies and the earth; nor, from one's knowledge of their connection by means of gravity, would one expect any thing else. Cf. supra, II. 18.

manens in statu; sive animal, sive vegetabile, sive minerale; sive aqua, sive oleum, sive aër; aut aliqua alia substantia quæcunque susceptiva motus prædicti. Calidum autem ad sensum res eadem est: sed cum analogia, qualis competit sensui. Nunc vero ad ulteriora auxilia procedendum est.

XXI.

Post *Tabulas comparentiæ primæ*, et *rejectionem* sive *exclusivam*, nec non *vindemiationem primam* factam secundum eas; pergendum est ad reliqua auxilia intellectus, circa *interpretationem naturæ*, et *inductionem* veram ac perfectam. In quibus proponendis, ubi opus erit tabulis, procedemus super calidum et frigidum[40]; ubi autem opus erit tantum exemplis paucioribus, procedemus per alia omnia: ut nec confundatur inquisitio, et tamen doctrina versetur minus in angusto.

Dicemus itaque primo loco, de *prærogativis instantiarum*[41]: secundo, de *adminiculis inductionis*: tertio, de *rectificatione inductionis*: quarto, de *variatione inquisitionis pro natura subjecti*: quinto, de *prærogativis naturarum* quatenus ad inquisitionem, sive de eo quod inquirendum est prius et posterius: sexto, de *terminis inquisitionis*, sive de *synopsi* omnium *naturarum* in universo: septimo, de *deductione ad praxin*, sive de eo

[40] This shews that Bacon did not consider the Form of Heat to be yet discovered, unless the discussion in II. 11–20 be supposed to be a sample of the results of the whole Method.

[41] *Prærogativæ* refers to the Roman system of voting by centuries. That which voted first was called the Prærogative Century; and it was usually found that by some prejudice or superstition it influenced the rest, which seldom voted otherwise. Cf. Cic. pro Mur. xviii. By this name Bacon denoted "characteristic phenomena, selected from the great mass of facts existing in nature. Phenomena so selected on account of some peculiarly forcible way in which they strike the reason, and impress us with a kind of sense of causation, or a particular aptitude for generalization, he considers, and justly, as holding a kind of prerogative dignity, and claiming our first and especial attention in physical enquiries." Herschel's Discourse, § 190.

quod est in ordine ad hominem: octavo, de *parascevis ad inquisitionem:* postremo autem, de *scala ascensoria et descensoria axiomatum*[42].

XXII[43].

Inter *prærogativas instantiarum*, primo proponemus *instantias solitarias.* Eæ autem sunt *solitariæ*, quæ exhibent naturam[44], de qua fit inquisitio, in talibus subjectis, quæ nil habent commune cum aliis subjectis, præter illam ipsam naturam: aut rursus quæ non exhibent naturam, de quo fit inquisitio, in talibus subjectis, quæ sunt similia per omnia cum aliis subjectis, præterquam in illa ipsa natura. Manifestum enim est, quod hujusmodi instantiæ tollant ambages, atque accelerent et roborent *exclusivam;* adeo ut paucæ ex ilis sint instar multarum.

Exempli gratia: si fiat inquisitio de natura *coloris*[45],

[42] Of these nine "Auxilia intellectus," one only has been perfectly accomplished. We have fragments of some of the others, but no more. When we consider that these nine Auxilia are only the subdivisions of this second part of the Instauratio Magna, we begin to discern the magnificent proportions of Bacon's design, and at the same time the small portion of it which the great Architect completed.

[43] The *"Prerogatives of* (or *among*) *Instances"* are divided into three heads:

(1) 1—15. Those which address themselves to the Understanding.

(2) 16—20. Those which assist the Senses.

(3) 21—27. Those which tend to practice.

There is not much arrangement; and the whole attempt is far too cumbrous for general use. The titles, too, and the subdivisions, are often fanciful. Particular "Prerogatives" are, however, practically speaking, continually being made use of.

[44] "Quæ exhibent *Naturam.*" Playfair translates this word by *Quality:* perhaps it is better to retain the ambiguous term which Bacon uses. Solitary instances are of two kinds: (1) where the same "nature" exists in two bodies which have no other point in common: (2) where things entirely alike in all other respects differ in some one point, as veins of black and white in the same marble: or colours in the same flower. These *Solitary Instances* are much the same with Mill's two first Experimental Methods, (1) that of Agreement, (2) that of Difference. Mill's Logic, III. viii. § 1, 2.

[45] It was by these same instances of Colour that Sir I. Newton found

instantiæ solitariæ sunt prismata, gemmæ crystallinæ, quæ reddunt colores, non solum in se, sed exterius supra parietem. Item rores, &c. Istæ enim nil habent commune cum coloribus fixis in floribus, gemmis coloratis, metallis, lignis, &c. præter ipsum colorem. Unde facile colligitur, quod color nil aliud sit quam modificatio imaginis lucis immissæ et receptæ: in priore genere, per gradus diversos incidentiæ; in posteriore, per texturas et schematismos varios corporis. Istæ autem *instantiæ* sunt *solitariæ* quatenus ad similitudinem.

Rursus in eadem inquisitione, venæ distinctæ albi et nigri in marmoribus, et variegationes colorum in floribus ejusdem speciei, sunt *instantiæ solitariæ.* Album enim et nigrum marmoris, et maculæ albi et purpurei in floribus caryophylli[46], conveniunt fere in omnibus præter ipsum colorem. Unde facile colligitur, colorem non multum rei habere cum naturis alicujus corporis intrinsecis, sed tantum situm esse in positura partium crassiori et quasi mechanica. Istæ autem *instantiæ* sunt *solitariæ,* quatenus ad discrepantiam. Utrunque autem genus, *instantias solitarias* appellare consuevimus, aut *ferinas*[47], sumpto vocabulo ab astronomis.

XXIII.

Inter prærogativas instantiarum, ponemus secundo loco *instantias migrantes*[48]. Eæ sunt, in quibus natura

out the Composition of Light. Cf. Herschel's Discourse, § 18 and 275. Bacon's account approaches the truth, and shews great shrewdness.

[46] *Caryophyllon*, καρυοφύλλον, the Clove-Gillyflower.

[47] *Ferinæ.* I have met with nothing that throws light on this word. Can it refer to such irregularities as the old astronomers observed, and could not reduce into agreement with their system?

[48] Instances in which one quality vanishes as another is induced, or in which one quality decreases as another increases. Water changing into Steam, or into Ice, would be a fair example. This class of Instances approaches very nearly to the investigation of Latent Process. Playfair, Encycl. Brit. (Diss. iii. p. 462) says of these instances, "Such are the Shells which we see so perfect in figure and structure in Lime-

inquisita migrat ad generationem, cum prius non existeret; aut contra migrat ad corruptionem, cum prius existeret. Itaque in utraque antistrophe, instantiæ tales sunt semper geminæ; vel potius una instantia in motu, sive transitu, producta ad periodum adversam. At hujusmodi instantiæ non solum accelerant et roborant *exclusivam*, sed etiam compellunt *affirmativam*, sive formam ipsam, in angustum. Necesse est enim ut forma rei sit quippiam, quod per hujusmodi *migrationem* indatur; aut contra per hujusmodi *migrationem* tollatur, et destruatur. Atque licet omnis exclusio promoveat *affirmativam*, tamen hoc magis directe fit in subjecto eodem, quam in diversis. Forma autem (ut ex omnibus, quæ dicta sunt, manifesto liquet) prodens se in uno, ducit ad omnia. Quo autem simplicior fuerit *migratio*, eo magis habenda est instantia in pretio. Præterea *instantiæ migrantes* magni sunt usus ad partem operativam; quia cum proponant formam copulatam cum efficiente aut privante, perspicue designant praxin in aliquibus; unde facilis etiam est transitus ad proxima[49]. Subest tamen in illis nonnihil periculi, quod indiget cautione; hoc videlicet, ne formam nimis retrahant ad efficientem, et intellectum perfundant, vel saltem perstringant, falsa opinione de forma, ex intuitu efficientis. Efficiens vero semper ponitur nil aliud esse, quam vehiculum, sive deferens formæ. Verum huic rei, per *exclusivam* legitime factam, facile adhibetur remedium.

stone, which gradually lose themselves in the finer Marbles, till they can no longer be distinguished." See Herschel's Discourse, § 198, 199. "The travelling Instances are cases in which we are enabled to trace that general law which seems to pervade all Nature—the law, as it is termed, of Continuity, and which is expressed in the well-known sentence, 'Natura non agit per saltum.'"

[49] This is quite true. For "Migrating Instances" are simply registers of phenomena arising from the application (naturally or otherwise) of some agency to a substance. Chemistry is full of such cases.

Proponendum itaque est jam exemplum *instantiæ migrantis*. Sit natura inquisita, candor, sive albedo; *instantia migrans* ad generationem est vitrum integrum, et vitrum pulverisatum. Similiter, aqua simplex, et aqua agitata in spumam. Vitrum enim integrum, et aqua simplex, diaphana sunt, non alba: at vitrum pulverisatum, et aqua in spuma, alba, non diaphana[50]. Itaque quærendum, quid acciderit ex ista *migratione* vitro, aut aquæ. Manifestum enim est, formam albedinis deferri et invehi per istam contusionem vitri, et agitationem aquæ. Nihil autem reperitur accessisse, præter comminutionem partium vitri et aquæ, et aëris insertionem. Neque vero parum profectum est ad inveniendam formam albedinis, quod corpora duo per se diaphana, sed secundum magis et minus, (aër scilicet et aqua, aut aër et vitrum) simul posita per minutas portiones, exhibeant albedinem, per refractionem inæqualem radiorum lucis.

Verum hac in re proponendum est etiam exemplum periculi et cautionis, de quibus diximus. Nimirum facile hic occurret intellectui ab hujusmodi efficientibus depravato, quod ad formam albedinis aër semper requiratur; aut quod albedo generetur tantum per corpora diaphana: quæ omnino falsa sunt, et per multas exclusiones convicta. Quin potius apparebit, (misso aëre, et hujusmodi) corpora omnino æqualia (secundum portiones opticas) dare diaphanum; corpora vero in-

[50] In their whole and undisturbed state glass and water allow the rays of light to pass through them and refract only a little; consequently they give us no sensation of whiteness: when the glass is pounded, it no longer allows of refraction as before; and the rays of light being reflected in great quantities in their natural state, convey to the eye the impression of whiteness. "In reading this, and many other instances in the Nov. Org." says Herschel, (Disc. § 198) "one would almost suppose (had it been written) that its author had taken them from Newton's Optics."

æqualia, per texturam simplicem, dare album; corpora inæqualia secundum texturam compositam sed ordinatam, dare reliquos colores, præter nigrum; corpora vero inæqualia per texturam compositam, sed omnino inordinatam et confusam, dare nigrum. Itaque de *instantia migrante* ad generationem in natura inquisita albedinis, propositum est jam exemplum. *Instantia* autem *migrans* ad corruptionem in eadem natura albedinis, est spuma dissoluta, aut nix dissoluta: exuit enim albedinem, et induit diaphanum aqua, post quam fit integrale sine aëre.

Neque vero illud ullo modo prætermittendum est, quod sub *instantiis migrantibus* comprehendi debeant non tantum illæ quæ migrant ad generationem et privationem; sed etiam illæ quæ *migrant* ad majorationem et minorationem; cum illæ etiam tendant ad inveniendam formam, ut per definitionem formæ superius factam, et *tabulam graduum*, manifesto liquet. Itaque papyrus, quæ sicca quum fuerit, alba est; at madefacta (excluso aëre, et recepta aqua) minus alba est, et magis vergit ad diaphanum; similem habet rationem cum instantiis supradictis.

XXIV.

Inter prærogativas instantiarum, tertio loco ponemus *instantias ostensivas*, de quibus in *vindemiatione prima de calido* mentionem fecimus; quas etiam *elucescentias*, sive *instantias liberatas, et prædominantes*, appellare consuevimus[51]. Eæ sunt, quæ ostendunt naturam in-

[51] Cf. supr. II. 20. These "Glaring Instances" shew the Nature or Quality sought for in its highest power or degree, and freed from ordinary obstructions. See Herschel's Discourse, § 191, 192. These will always be those striking cases, which most often lead to valuable discoveries. One or two of these in skilful hands have often led to Truth when no application of the Baconian Method has been thought of. Herschel (Discourse, § 365) adduces Magne-

quisitam nudam et substantivam, atque etiam in exaltatione sua, aut summo gradu potentiæ suæ; emancipatam scilicet, et liberatam ab impedimentis, vel saltem per fortitudinem suæ virtutis dominantem super ipsa, eaque supprimentem et coercentem. Cum enim omne corpus suscipiat multas naturarum formas copulatas, et in concreto; fit ut alia aliam retundat, deprimat, frangat, et liget; unde obscurantur formæ singulæ. Inveniuntur autem subjecta nonnulla, in quibus natura inquisita præ aliis est in suo vigore, vel per absentiam impedimenti, vel per prædominantiam virtutis. Hujusmodi autem *instantiæ* sunt maxime *ostensivæ* formæ. Verum et in his ipsis instantiis adhibenda est cautio, et cohibendus impetus intellectus. Quicquid enim ostentat formam, eamque trudit, ut videatur occurrere intellectui, pro suspecto habendum est, et recurrendum ad *exclusivam* severam et diligentem.

Exempli gratia; sit natura inquisita, calidum. *Instantia ostensiva* motus expansionis (quæ, ut superius dictum est, portio est præcipua formæ calidi) est vitrum calendare aëris. Etenim flamma, licet manifesto exhibeat expansionem; tamen propter momentaneam extinctionem non ostendit progressum expansionis. Aqua autem fervens, propter facilem transitionem aquæ in vaporem et aërem, non tam bene ostendit expansionem aquæ in corpore suo. Rursus ferrum ignitum, et similia, tantum abest ut progressum ostendant, ut contra per retusionem et fractionem spiritus per partes compactas et crassas, (quæ domant et frænant expansionem) ipsa expansio non sit omnino conspicua ad sensum[52].

tism as a "Glaring Instance of Polarity."

[52] Cf. supr. II. 18. Inst. 10, and in the Differentia 1ma of Motus for Heat in II. 20. Bacon seems very desirous of keeping up a marked distinction between expansion, "per particulas minores," and "secundum totum."

At vitrum calendare clare ostendit expansionem in aëre, et conspicuam, et progredientem, et durantem, neque transeuntem.

Rursus, exempli gratia, sit natura inquisita, pondus. *Instantia ostensiva* ponderis est argentum vivum[53]. Omnia enim superat pondere magno intervallo, præter aurum; quod non multo gravius est. At præstantior instantia est ad indicandam formam ponderis argentum vivum, quam aurum; quia aurum solidum est, et consistens, quod genus referri videtur ad densum; et argentum vivum liquidum est, et turgens spiritu, at tamen multis partibus exuperat gravitate diamantem, et ea quæ putantur solidissima. Ex quo ostenditur, formam gravis, sive ponderosi, dominari simpliciter in copia materiæ, et non in arcta compage[54].

XXV.

Inter prærogativas instantiarum ponemus quarto loco *instantias clandestinas*, quas etiam *instantias crepusculi* appellare consuevimus[55]. Eæ sunt veluti oppositæ *instantiis ostensivis*. Exhibent enim naturam inquisitam in infima virtute, et tanquam in incunabulis, et rudimentis suis; tentantem, et tanquam primo expe-

[53] This is not a good Instance; for gold, which is heavier than quicksilver, also becomes fluid by the application of Heat; and quicksilver is solid at a certain temperature.

[54] "dominari in." This phrase seems to refer to Bacon's name of *Prædominantes* Instantiæ; "rules over."

[55] These Clandestine Instances are the contrary of the last. The "Nature" sought for is in its weakest and most imperfect state. The illustration—of the cohesion of fluids—is an excellent one; and leads Bacon to the correct result, viz. "liquidum et consistens esse notiones tantum plebeias, &c."

"This class of Instances is of great use, being, in fact, frequently no other than that of *extreme cases*, which, by placing our conclusions, as it were, in violent circumstances, try their temper, and bring their vigour into test." Herschel's Discourse, § 193. They will be chiefly applicable, then, after our conclusion has been arrived at.

rientem, sed sub contraria natura latentem, et subactam. Sunt autem hujusmodi *instantiæ* magni omnino momenti, ad inveniendas formas; quia sicut *ostensivæ* ducunt facile ad differentias, ita *clandestinæ* ducunt optime ad genera; id est, ad naturas illas communes, quarum naturæ inquisitæ nihil aliud sunt quam limitationes.

Exempli gratia; sit natura inquisita, consistens, sive se determinans; cujus contrarium est liquidum, sive fluens. *Instantiæ clandestinæ* sunt illæ, quæ exhibent gradum nonnullum debilem et infirmum consistentis in fluido; veluti bulla aquæ, quæ est tanquam pellicula quædam consistens, et determinata, facta ex corpore aquæ. Similiter stillicidia, quæ, si adfuerit aqua quæ succedat, producunt se in filum admodum tenue, ne discontinuetur aqua; at si non detur talis copia aquæ, quæ succedere possit, cadit aqua in guttis rotundis, quæ est figura, quæ optime aquam sustinet contra discontinuationem[56]. At in ipso temporis articulo, cum desinit filum aquæ, et incipit descensus in guttis, resilit ipsa aqua sursum ad evitandam discontinuationem. Quin in metallis, quæ quum funduntur sunt liquida, sed magis tenacia, recipiunt se sæpe guttæ liquefactæ sursum, atque ita hærent. Simile quiddam est in instantia speculorum puerilium, quæ solent facere pueruli in scirpis ex saliva, ubi cernitur etiam pellicula consistens aquæ. At multo melius se ostendit hoc ipsum in altero illo ludicro puerili; quando capiunt aquam, per saponem factam paulo tenaciorem, atque inflant eam per calamum cavum, atque inde formant aquam, tanquam in castellum bullarum; quæ per interpositionem aëris inducit consistentiam, eo usque ut se

[56] Compare the 5th kind of Motion, infr. II. 48, "Motus *continuationis*."

projici nonnihil patiatur absque discontinuatione. Optime autem cernitur hoc in spuma et nive: quæ talem induunt consistentiam, ut fere secari possint; cum tamen sint corpora formata ex aëre et aqua, quæ utraque sunt liquida. Quæ omnia non obscure innuunt, liquidum et consistens esse notiones tantum plebeias, et ad sensum; inesse autem revera omnibus corporibus fugam et evitationem se discontinuandi; eam in corporibus homogeneis (qualia sunt liquida) esse debilem et infirmam; in corporibus vero, quæ sunt composita ex heterogeneis, magis esse vividam et fortem: propterea quod admotio heterogenei constringit corpora; at subintratio homogenei solvit et relaxat.

Similiter, exempli gratia; sit natura inquisita, attractio, sive coitio corporum. *Instantia* circa formam ejus *ostensiva* maxime insignis est, magnes. Contraria autem natura attrahenti est, non attrahens; licet in substantia simili. Veluti ferrum, quod non attrahit ferrum, quemadmodum nec plumbum plumbum, nec lignum lignum, nec aquam aqua. *Instantia* autem *clandestina* est magnes ferro armatus, vel potius ferrum in magnete armato. Nam ita fert natura, ut magnes armatus in distantia aliqua non trahat ferrum fortius, quam magnes non armatus. Verum si admoveatur ferrum, ita ut tangat ferrum in magnete armato, tunc magnes armatus longe majus pondus ferri sustinet, quam magnes simplex et inermis; propter similitudinem substantiæ ferri versus ferrum; quæ operatio erat omnino *clandestina*, et latens in ferro, antequam magnes accessisset. Itaque manifestum est, formam coitionis esse quippiam, quod in magnete sit vividum et robustum, in ferro debile et latens. Itidem, notatum est sagittas parvas ligneas absque cuspide ferrea, emissas ex sclopetis grandibus, altius penetrare in materiam

ligneam, (puta latera navium, aut similia) quam easdem sagittas ferro acuminatas, propter similitudinem substantiæ ligni ad lignum, licet hoc ante in ligno latuerit. Itidem, licet aër aërem, aut aqua aquam manifesto non trahat in corporibus integris; tamen bulla approximata bullæ, facilius dissolvit bullam, quam si bulla illa altera abesset, ob appetitum coitionis aquæ cum aqua, et aëris cum aëre. Atque hujusmodi *instantiæ clandestinæ* (quæ sunt usus nobilissimi, ut dictum est) in portionibus corporum parvis et subtilibus maxime se dant conspiciendas: quia massæ rerum majores sequuntur formas magis catholicas et generales; ut suo loco dicetur[57].

XXVI.

Inter prærogativas instantiarum ponemus quinto loco *instantias constitutivas*, quas etiam *manipulares* appellare consuevimus[58]. Eæ sunt, quæ constituunt unam speciem naturæ inquisitæ tanquam formam minorem. Cum enim formæ legitimæ (quæ sunt semper convertibiles cum naturis inquisitis) lateant in profundo, nec facile inveniantur; postulat res et infirmitas humani intellectus, ut formæ particulares, quæ sunt congregativæ *manipulorum* quorundam instantiarum (neutiquam

[57] It is difficult to say what Bacon's meaning is in this passage.

[58] "Collective Instances, in Bacon's classification, are no other than general facts, or laws of some degree of generality, and are themselves the results of Induction." Herschel's Disc. § 194. Bacon seems to think it right to apologise; and says that they constitute "tanquam formam minorem." How any Nature in his system can have lesser and larger Forms seems hard to be understood. Apart from his desire for "Forms," these Instances are most valuable. It is, however, strange that though Kepler's Laws had been published, he makes no reference to them. They were exactly what he meant by Collective Instances; and afterwards aided Newton in his discovery of the more general "Law" of Gravitation. But Bacon never illustrates from Mathematics, and very rarely from the discoveries of his cotemporaries.

vero omnium) in notionem aliquam communem, non negligantur, verum diligentius notentur. Quicquid enim unit naturam, licet modis imperfectis, ad inventionem formarum viam sternit. Itaque instantiæ, quæ ad hoc utiles sunt, non sunt contemnendæ potestatis, sed habent nonnullam prærogativam.

Verum in his diligens est adhibenda cautio, ne intellectus humanus, postquam complures ex istis formis particularibus adinvenerit, atque inde partitiones sive divisiones naturæ inquisitæ confecerit; in illis omnino acquiescat, atque ad inventionem legitimam formæ magnæ se non accingat; sed præsupponat, naturam velut a radicibus esse multiplicem et divisam, atque ulteriorem naturæ unionem, tanquam rem supervacuæ subtilitatis, et vergentem ad merum abstractum, fastidiat et rejiciat.

Exempli gratia; sit natura inquisita, memoria[59], sive excitans et adjuvans memoriam. *Instantiæ constitutivæ* sunt; (1) ordo, sive distributio, quæ manifesto juvat memoriam. Item loci in memoria artificiali; qui aut possunt esse loci secundum proprium sensum, veluti janua, angulus, fenestra, et similia; aut possunt esse personæ familiares et notæ; aut possunt esse quidvis ad placitum, (modo in ordine certo ponantur) veluti animalia, herbæ; etiam verba, literæ, characteres, personæ historicæ, et cætera; licet nonnulla ex his magis apta sint et commoda, alia minus. Hujusmodi autem loci memoriam insigniter juvant, eamque longe supra vires naturales exaltant. Item carmina facilius hærent, et discuntur memoriter, quam prosa.

[59] This is a vague and unsatisfactory example. Its chief value is, that it shews how widely Bacon was disposed to apply his system; so as to make his Method useful in Psychology, or Morals, as well as in Physics. For his views on Memory see De Augm. Scient. V., where he places it third among the Arts Logical or Intellectual. See also Adv. of Learning, p. 198, where it is divided into Prenotion and Emblem.

Atque ex isto *manipulo* trium instantiarum, videlicet ordinis, locorum artificialis memoriæ, et versuum, constituitur species una auxilii ad memoriam. Species autem illa, *abscissio infiniti* recte vocari possit. Cum enim quis aliquid reminisci aut revocare in memoriam nititur; si nullam prænotionem habeat aut perceptionem ejus quod quærit, quærit certe et molitur, et hac illac discurrit, tanquam in infinito. Quod si certam aliquam prænotionem habeat, statim abscinditur infinitum, et fit discursus memoriæ magis in vicino. In tribus autem illis instantiis, quæ superius dictæ sunt, prænotio perspicua est et certa. In prima videlicet debet esse aliquid, quod congruat cum ordine: in secunda debet esse imago, quæ relationem aliquam habeat, sive convenientiam ad illa loca certa: in tertia debent esse verba, quæ cadant in versum. Atque ita abscinditur infinitum. (2) Aliæ autem instantiæ dabunt hanc alteram speciem; ut quicquid deducat intellectuale ad feriendum sensum (quæ ratio etiam præcipue viget in artificiali memoria) juvet memoriam. (3) Aliæ instantiæ dabunt hanc alteram speciem; ut quæ faciunt impressionem in affectu forti, incutientia scilicet metum, admirationem, pudorem, delectationem, juvent memoriam. (4) Aliæ instantiæ dabunt hanc alteram speciem, ut quæ maxime imprimuntur a mente pura, et minus præoccupata ante vel post; veluti quæ discuntur in pueritia, aut quæ commentamur ante somnum, etiam primæ quæque rerum vices; magis hæreant in memoria. (5) Aliæ instantiæ dabunt hanc alteram speciem, ut multitudo circumstantiarum, sive ansarum, juvet memoriam; veluti scriptio per partes non continuatas; lectio, sive recitatio voce alta. (6) Aliæ denique instantiæ dabunt hanc alteram speciem, ut quæ exspectantur, et attentionem excitant, melius hæreant,

quam quæ prætervolant. Itaque si scriptum aliquod vicies perlegeris, non tam facile illud memoriter disces, quam si illud legas decies, tentando interim illud recitare, et ubi deficit memoria, inspiciendo librum. Ita ut sint veluti sex formæ minores eorum, quæ juvant memoriam; videlicet, abscissio infiniti; deductio intellectualis ad sensibile; impressio in affectu forti; impressio in mente pura; multitudo ansarum; præexspectatio.

Similiter, exempli gratia; sit natura inquisita, gustus, sive gustatio. *Instantiæ*, quæ sequuntur, sunt *constitutivæ:* videlicet, quod qui non olfaciunt, sed sensu eo a natura destituti sunt, non percipiant, aut gustu distinguant cibum rancidum, aut putridum; neque similiter alliatum, aut rosatum, aut hujusmodi. Rursus, illi, qui per accidens nares habent per descensum rheumatis obstructas, non discernunt aut percipiunt aliquid putridum, aut rancidum, aut aqua rosacea inspersum. Rursus, qui afficiuntur hujusmodi rheumate, si in ipso momento, cum aliquid fœtidum aut odoratum habent in ore, sive palato, emungant fortiter; in ipso instanti manifestam perceptionem habent rancidi vel odorati. Quæ instantiæ dabunt et constituent hanc speciem, vel partem potius gustus; ut sensus gustationis ex parte nihil aliud sit, quam olfactus interior, transiens et descendens a narium meatibus superioribus in os et palatum. At contra, salsum, et dulce, et acre, et acidum, et austerum, et amarum, et similia; hæc (inquam) omnia æque sentiunt illi, in quibus olfactus deest, aut obturatur, ac quisquam alius: ut manifestum sit, sensum gustus esse compositum quiddam ex olfactu interiori, et tactu quodam exquisito[60]; de quo nunc non est dicendi locus.

[60] All Sensations are reducible to that of Touch.

Similiter, exempli gratia; sit natura inquisita, communicatio qualitatis, absque commistione substantiæ. Instantia lucis dabit vel constituet unam speciem communicationis; calor vero et magnes, alteram. Communicatio enim lucis est tanquam momentanea, et statim perit, amota luce originali[61]. At calidum, et virtus magnetica, postquam transmissa fuerint, vel potius excitata in alio corpore, hærent et manent ad tempus non parvum, amoto primo movente.

Denique magna est omnino prærogativa *instantiarum constitutivarum;* ut quæ plurimum faciant et ad definitiones, (præsertim particulares) et ad divisiones, sive partitiones naturarum; de quo non male dixit Plato[62], *Quod habendus sit tanquam pro Deo, qui definire et dividere bene sciat.*

XXVII.

Inter prærogativas instantiarum ponemus sexto loco *instantias conformes*, sive *proportionatas;* quas etiam *parallelas*, sive *similitudines physicas*, appellare consuevimus[63]. Eæ vero sunt, quæ ostendunt similitudines et conjugationes rerum, non in formis minoribus (quod faciunt *instantiæ constitutivæ*) sed plane in concreto. Itaque sunt tanquam primi et infimi gradus ad unio-

[61] Rays of light do not remain in the air, while rays of Heat are detained by it. Cf. II. 13. Inst. 35.

[62] Plato, Phædrus, 266 a. *Τούτων δὴ ἔγωγε αὐτός τε ἐραστὴς τῶν διαιρέσεων, καὶ συναγαγῶν, ἵν' οἷός τε ὦ λέγειν τε καὶ φρονεῖν· ἐάν τε τινά ἄλλον ἡγήσωνται δυνατὸν εἰς ἓν καὶ ἐπὶ πολλὰ πεφυκότα ὁρᾶν, τοῦτον διώκω —— κατόπισθε μετ' ἴχνιον ὥστε θεοῖο.*

[63] Prerogatives 6–10 are preparative (cf. infr. II. 32.), and are to go first into the inquiry into Nature, and to lead towards Practice.

"Conformable Instances" are facts which resemble one another in some points *in concretes*, not in their more general Laws. Harvey's discovery of the circulation of the blood from the valves in Hydraulic engines and in the veins would be a case in point. It was the analogy between the Human Eye and the Telescope that led to the formation of Achromatic lenses. Cf. Adv. of Learning, p. 130.

nem naturæ. Neque constituunt aliquod axioma statim ab initio; sed indicant et observant tantum quendam consensum corporum. Attamen licet non multum promoveant ad inveniendas formas; nihilominus magna cum utilitate revelant partium universi fabricam, et in membris ejus exercent veluti anatomiam quandam; atque proinde veluti manu ducunt interdum ad axiomata sublimia et nobilia; præsertim illa, quæ ad mundi configurationem pertinent, potius quam ad naturas et formas simplices.

Exempli gratia; instantiæ conformes sunt, quæ sequuntur; speculum, et oculus; et similiter fabrica auris, et loca reddentia echo. Ex qua conformitate, præter ipsam observationem similitudinis, quæ ad multa utilis est, proclive est insuper colligere et formare illud axioma; videlicet, organa sensuum et corpora, quæ pariunt reflexiones ad sensus, esse similis naturæ. Rursus ex hoc ipso admonitus intellectus, non ægre insurgit ad axioma quoddam altius et nobilius. Hoc nimirum; nihil interesse inter consensus sive sympathias corporum sensu præditorum, et inanimatorum sine sensu; nisi quod in illis accedat spiritus animalis[64] ad corpus rite dispositum; in his autem absit. Adeo ut quot sint consensus in corporibus inanimatis, tot possint esse sensus in animalibus, si essent perforationes in corpore animato, ad discursum spiritus animalis in membrum rite dispositum, tanquam in organum idoneum. Et rursus, quot sint sensus in animalibus, tot sint proculdubio motus in corpore inanimato, ubi spiritus animalis abfuerit; licet necesse sit multo plures esse motus

[64] Bacon discusses "Animal Spirits" at length infr. II. 40. I have ventured to read "*rite* dispositum" for the old reading "*ita* dispositum," which could scarcely have been correct. *Rite* seems probable, especially as the phrase occurs just below under similar circumstances.

in corporibus inanimatis, quam sensus in animatis, propter paucitatem organorum sensus. Atque hujus rei ostendit se exemplum valde manifestum in doloribus. Etenim quum sint plura genera doloris in animalibus, et tanquam varii illius characteres, (veluti alius est dolor ustionis, alius frigoris intensi, alius puncturæ, alius compressionis, alius extensionis, et similium) certissimum est omnia illa, quoad motum, inesse corporibus inanimatis; veluti ligno, aut lapidi, cum uritur, aut per gelu constringitur, aut pungitur, aut scinditur, aut flectitur, aut tunditur; et sic de aliis; licet non subintrent sensus, propter absentiam spiritus animalis.

Item *instantiæ conformes*[65] (quod mirum fortasse dictu) sunt radices et rami plantarum. Omne enim vegetabile intumescit, et extrudit partes in circumferentiam, tam sursum quam deorsum. Neque alia est differentia radicum et ramorum, quam quod radix includatur in terra, et rami exponantur aëri et soli. Si quis enim accipiat ramum tenerum et vegetum arboris, atque illum reflectat in aliquam terræ particulam, licet non cohæreat ipsi solo, gignit statim non ramum, sed radicem. Atque vice versa, si terra ponatur superius, atque ita obstruatur lapide, aut aliqua dura substantia, ut planta cohibeatur, nec possit frondescere sursum, edet ramos in aërem deorsum.

Item *instantiæ conformes* sunt, gummi arborum, et pleræque gemmæ rupium. Utraque enim nil aliud sunt, quam exsudationes et percolationes succorum[66]: in primo genere scilicet, succorum ex arboribus; in secundo, ex saxis; unde gignitur claritudo et splendor in

[65] Many of these examples are very fanciful and useless.

[66] This will scarcely do for the origin of gems: which are connected with Crystallisation.

utrisque, per percolationem nimirum tenuem et accuratam. Nam inde fit etiam, quod pili animalium non sint tam pulchri, et tam vividi coloris, quam avium plumæ complures; quia succi non tam delicate percolantur per cutem, quam per calamum.

Item *instantiæ conformes* sunt, scrotum in animalibus masculis; et matrix in fœmellis. Adeo ut nobilis illa fabrica, per quam sexus differunt, (quatenus ad animalia terrestria) nil aliud videatur esse, quam secundum exterius et interius; vi scilicet majore caloris genitalia in sexu masculo protrudente in exterius, ubi in fœmellis nimis debilis est calor, quam ut hoc facere possit; unde accidit, quod contineantur interius.

Item *instantiæ conformes* sunt, pinnæ piscium, et pedes quadrupedum, aut pedes et alæ volucrum, quibus addidit Aristoteles quatuor volumina in motu serpentum[67]. Adeo ut in fabrica universi, motus viventium plerunque videatur expediri per quaterniones artuum, sive flexionum.

Item dentes in animalibus terrestribus, et rostra in avibus, sunt *instantiæ conformes*; unde manifestum est, in omnibus animalibus perfectis fluere duram quandam substantiam versus os.

Item non absurda est similitudo et conformitas illa, ut homo sit tanquam planta inversa. Nam radix nervorum et facultatum animalium est caput; partes autem seminales sunt infimæ, non computatis extremitatibus tibiarum et brachiorum. At in planta, radix (quæ instar capitis est) regulariter infimo loco collocatur; semina autem supremo.

Denique illud omnino præcipiendum est, et sæpius

[67] Aristotle's addition is erroneous; and Bacon's generalizations, both here and below, are hasty.

monendum; ut diligentia hominum in inquisitione et congerie naturalis historiæ deinceps mutetur plane, et vertatur in contrarium ejus, quod nunc in usu est. Magna enim hucusque atque adeo curiosa fuit hominum industria, in notanda rerum varietate, atque explicandis accuratis animalium, herbarum, et fossilium differentiis; quarum pleræque magis sunt lusus naturæ, quam seriæ alicujus utilitatis versus scientias. Faciunt certe hujusmodi res ad delectationem, atque etiam quandoque ad praxin; verum ad introspiciendam naturam parum, aut nihil. Itaque convertenda plane est opera ad inquirendas et notandas rerum similitudines et analoga, tam in integralibus, quam partibus: illæ enim sunt, quæ naturam uniunt, et constituere scientias incipiunt[68].

Verum in his omnino est adhibenda cautio gravis et severa; ut accipiantur pro *instantiis conformibus* et *proportionatis* illæ, quæ denotant similitudines (ut ab initio diximus) physicas; id est, reales et substantiales, et immersas in natura; non fortuitas et ad speciem; multo minus superstitiosas aut curiosas, quales naturalis magiæ scriptores (homines levissimi, et in rebus tam seriis, quales nunc agimus, vix nominandi) ubique ostentant; magna cum vanitate et desipientia inanes similitudines et sympathias rerum describentes, atque etiam quandoque affingentes.

Verum his missis, etiam in ipsa configuratione mundi in majoribus non sunt negligendæ *instantiæ conformes:* veluti Africa, et regio Peruviana, cum continente se porrigente usque ad fretum Magellanicum. Utraque

[68] This warning of Bacon's does not quite agree with his warning in I. 55. His own love of analogies would lead him to this: but surely more is to be learnt in Physics from noticing differences than resemblances.

enim regio habet similes isthmos, et similia promontoria, quod non temere accidit.

Item novus et vetus orbis; in eo quod utrique orbes versus septentriones lati sunt, et exporrecti; versus austrum autem angusti et acuminati[69].

Item *instantiæ conformes* nobilissimæ sunt, frigora intensa in media (quam vocant) aëris regione; et ignes acerrimi, qui sæpe reperiuntur erumpentes ex locis subterraneis: quæ duæ res sunt ultimitates et extrema; naturæ scilicet frigidi, versus ambitum cœli, et naturæ calidi versus viscera terræ; per antiperistasin, sive rejectionem naturæ contrariæ[70].

Postremo autem in axiomatibus scientiarum[71], notatu digna est *conformitas instantiarum*. Veluti tropus rhetoricæ, qui dicitur *præter expectatum*[72], conformis est tropo musicæ, qui vocatur *declinatio cadentiæ*[73]. Similiter, postulatum mathematicum, ut *quæ eidem tertio*

[69] This shape of all the countries, viz. the tending to a point towards the South, as in Japan, South America, India, Africa, is a physical fact which has been often noticed.

[70] These two are only *Analoga* in so far as their opposition increases or decreases regularly; degrees of Heat increasing as we penetrate—of Cold as we ascend. For *Antiperistasis*, see supr. II. 12. Inst. 24.

[71] Such, e.g. as in the case of the Intensity of Light varying exactly as the Intensity of Gravity does.

[72] "Præter expectatum," *παρ' ἀπροσδοκητόν*—anything which happens in a startling way contrary to what one was expecting.

[73] "Declinatio Cadentiæ." Explained in the Adv. of Learning, p. 130. "Is not the Trope of Music, *to avoid or slide from the close or cadence*, common with the Trope of Rhetoric of *deceiving expectation?*"—i. e. when you are expecting your player to end, he suddenly makes a fresh and unexpected start: see also Sylv. Sylv. 113. "At first I thought it meant a 'Cadenza d' Inganno,' or 'false cadence;' but I have now satisfied myself that such a thing was unknown in Bacon's time. I am rather inclined to think it refers to a species of false close, such as we find in the last bar but two of Tallis's Nunc Dimittis in D, where the Harmony proceeds to $\begin{smallmatrix}5\\4\end{smallmatrix}$ and $\begin{smallmatrix}5\\\sharp 3\end{smallmatrix}$ on A for a Bass, as though it were about to close immediately on the chord of D; when suddenly the Tenor strikes a C♮, which necessitates a modulation into the chord of G, thus leading to a 'Plagal Close.'" This is an explanation kindly forwarded me by Sir F. A. Gore Ouseley, Bart. M.A. and Prof. Mus. in the University of Oxford.

æqualia sunt, etiam inter se sint æqualia, conforme est cum fabrica syllogismi in logica, qui unit ea, quæ conveniunt in medio. Denique multum utilis est in quamplurimis sagacitas quædam in conquirendis et indagandis conformitatibus, et similitudinibus physicis[74].

XXVIII.

Inter *prærogativas instantiarum* ponemus septimo loco *instantias monodicas;* quas etiam *irregulares*, sive *heteroclitas* (sumpto vocabulo a grammaticis) appellare consuevimus[75]. Eæ sunt, quæ ostendunt corpora in concreto; quæ videntur esse extravagantia, et quasi abrupta in natura, et minime convenire cum aliis rebus ejusdem generis. Etenim *instantiæ conformes* sunt similes alterius: at *instantiæ monodicæ* sunt sui similes. Usus vero *instantiarum monodicarum* est talis, qualis est *instantiarum clandestinarum:* viz. ad evehendam et uniendam naturam ad invenienda genera, sive communes naturas, limitandas postea per differentias veras. Neque enim desistendum ab inquisitione, donec proprietates et qualitates, quæ inveniuntur in hujusmodi rebus, quæ possunt censeri pro miraculis naturæ, reducantur et comprehendantur sub aliqua forma sive lege

74 Some warning against the "Spirit of System" is needed in this Aphorism. The analogies are very fanciful, and often erroneous; and it seems throughout to be much at variance with the general spirit of his Method. This last section contains a hint of the *εὐστοχία*, "sagacitas quædam," required in those who study Physical Laws. It is not so much as Coleridge's "Mental Initiative," but only a kind of shrewdness in seeing connections between instances; a sort of rapid *θήρευσις ἀληθείας*, as Aristotle would have expressed it.

75 These *Singular* or irregular Instances are very valuable, as giving something 'out of course' and uncommon, within very narrow limits. Saturn's Rings would be a far better example than the Sun and Moon; and the Letter S is scarcely deserving of a place here. See Herschel's Discourse, § 364.

Instances 7, 8, & 9, might have all come under one head, for *Monodicæ* in Species are what *Deviantes* are in Individuals, and *Limitaneæ* are offshoots of *Monodicæ*, being those cases in which two species seem to have transgressed one another's limits.

certa: ut irregularitas sive singularitas omnis reperiatur pendere ab aliqua forma communi; miraculum vero illud sit tandem solummodo in differentiis accuratis, et gradu, et concursu raro, et non in ipsa specie: ubi nunc contemplationes hominum non procedant ultra, quam ut ponant hujusmodi res pro secretis et magnalibus naturæ, et tanquam incausabilibus, et pro exceptionibus regularum generalium.

Exempla *instantiarum monodicarum* sunt, sol, et luna, inter astra; magnes, inter lapides; argentum vivum, inter metalla; elephas, inter quadrupedes; sensus veneris, inter genera tactus; odor venaticus in canibus, inter genera olfactus. Etiam S litera apud grammaticos habetur pro monodica; ob facilem compositionem, quam sustinet cum consonantibus, aliquando duplicibus, aliquando triplicibus: quod nulla alia litera facit. Plurimi autem faciendæ sunt hujusmodi instantiæ, quia acuunt et vivificant inquisitionem, et medentur intellectui depravato a consuetudine, et ab iis quæ fiunt plerunque.

XXIX.

Inter *prærogativas instantiarum* ponemus loco octavo *instantias deviantes*[76]; errores scilicet naturæ, et vaga, ac monstra: ubi natura declinat et deflectit a cursu ordinario. Differunt enim errores naturæ ab *instantiis monodicis* in hoc, quod *monodicæ* sint miracula specierum, at errores sint miracula individuorum. Similis autem fere sunt usus; quia rectificant intellectum adversus consueta, et revelant formas communes.

[76] These are *Lusus Naturæ* in individual cases, and differ from the Singular Instances in being opposed to the natural course of things, while the latter are not so, but are only strongly marked off from all other kinds by their special peculiarities. These do not lead to the discovery of Form; but to Latent Process: as they reveal peculiarities in Nature's course of Production.

Neque enim in his etiam desistendum ab inquisitione, donec inveniatur causa hujusmodi declinationis. Veruntamen causa illa non exsurgit ad formam aliquam proprie, sed tantum ad *latentem processum* ad formam. Qui enim vias naturæ noverit, is *deviationes* etiam facilius observabit. At rursus, qui *deviationes* noverit, is accuratius vias describet.

Atque in illo differunt etiam ab *instantiis monodicis*, quod multo magis instruant praxin et operativam. Nam novas species generare, arduum admodum foret: at species notas variare, et inde rara multa ac inusitata producere, minus arduum. Facilis autem transitus est a miraculis naturæ ad miracula artis[77]. Si enim deprehendatur semel natura in variatione sua, ejusque ratio manifesta fuerit; expeditum erit eo deducere naturam per artem, quo per casum aberraverit. Neque solum eo, sed et aliorsum; cum errores ex una parte monstrent et aperiant viam ad errores et deflexiones undequaque. Hic vero exemplis non est opus, propter eorundem copiam. Facienda enim est congeries sive historia naturalis particularis omnium monstrorum, et partuum naturæ prodigiosorum; omnis denique novitatis, et raritatis, et inconsueti in natura. Hoc vero faciendum est cum severissimo delectu, ut constet fides. Maxime autem habenda sunt pro suspectis, quæ pendent quomodocunque a religione; ut prodigia Livii: nec minus, quæ inveniuntur in scriptoribus magiæ naturalis, aut etiam alchymiæ, et hujusmodi hominibus; qui tanquam proci sunt et amatores fabularum. Sed depromenda sunt illa ex gravi et fida historia, et auditionibus certis.

77 *τέχνη τύχην ἔστερξε καὶ τύχη τέχνην.* Ar. Eth. Nic. VI. 4. 5.

By watching the changes in Nature we may learn to produce similar changes in individuals. New species we hardly may be able to create, but new varieties we can, as in Horticulture.

XXX.

Inter *prærogativas instantiarum* ponemus loco nono *instantias limitaneas;* quas etiam *participia* vocare consuevimus[78]. Eæ vero sunt, quæ exhibent species corporum tales, quæ videntur esse compositæ ex speciebus duabus, vel rudimenta inter speciem unam et alteram. Hæ vero instantiæ inter *instantias monodicas* sive *heteroclitas* recte numerari possunt: sunt enim in universitate rerum raræ et extraordinariæ. Sed tamen ob dignitatem seorsim tractandæ et ponendæ sunt. Optime enim indicant compositionem et fabricam rerum, et innuunt causas numeri et qualitatis specierum ordinariarum in universo, et deducunt intellectum ab eo quod est, ad id quod esse potest.

Harum exempla sunt: muscus, inter putredinem et plantam; cometæ nonnulli, inter stellas et meteora ignita; pisces volantes, inter aves et pisces; vespertiliones, inter aves et quadrupedes: etiam

Simia quam similis, turpissima bestia, nobis[79];

et partus animalium biformes, et commisti ex speciebus diversis; et similia.

XXXI.

Inter *prærogativas instantiarum* ponemus decimo loco *instantias potestatis,* sive *fascium,* (sumpto vocabulo ab insignibus imperii;) quas etiam *ingenia,* sive *manus hominis,* appellare consuevimus[80]. Eæ sunt

78 These Limiting Instances or "participia," (i. e. partakers of two or more kinds, just as the Participle in Grammar participates in the nature of Verb and Noun,) exhibit a combination of two kinds, and so seem to stand between the Singular and the Deviating instances. Bacon's examples are not satisfactory. Moss is by no means "inter putredinem et plantam." Some of the Zoophytes, or the Ornithorhyncus Paradoxus would be better examples. Neither Flying-fish nor Bats are "limiting" between two kinds, except in appearance.

79 This line is quoted from Ennius in Cicero, De Nat. Deor. I. 35.

80 By Instances of Power, Bacon

opera maxime nobilia et perfecta, et tanquam ultima in unaquaque arte. Cum enim hoc agatur præcipue ut natura pareat rebus et commodis humanis; consentaneum est prorsus, ut opera, quæ jampridem in potestate hominis fuerunt, (quasi provinciæ antea occupatæ et subactæ) notentur et numerentur; præsertim ea, quæ sunt maxime enucleata et perfecta: propterea quod ab istis proclivior et magis in propinquo sit transitus ad nova et hactenus non inventa. Si quis enim ab horum contemplatione attenta propositum acriter et strenue urgere velit; fiet certe, ut aut producat illa paulo longius, aut deflectat illa ad aliquid, quod finitimum est; aut etiam applicet et transferat illa ad usum aliquem nobiliorem.

Neque hic finis: verum quemadmodum ab operibus naturæ raris et inconsuetis erigitur intellectus, et elevatur ad inquirendas et inveniendas formas, quæ etiam illorum sunt capaces; ita etiam in operibus artis egregiis et admirandis hoc usu venit. Idque multo magis; quia modus efficiendi et operandi hujusmodi miracula artis manifestus ut plurimum est; cum plerunque in miraculis naturæ sit magis obscurus. Attamen in his ipsis cautio est adhibenda vel maxime; ne deprimant scilicet intellectum, et eum quasi humo affigant.

Periculum enim est, ne per hujusmodi opera artis, quæ videntur velut summitates quædam et fastigia industriæ humanæ, reddatur intellectus attonitus et

includes within the limits of Observation of fact, the most remarkable productions of man's ingenuity, as well as the works of external Nature. Art has done and produced something: why should we not use that something as a stepping-stone towards farther advances? Another advantage is, that the productions of art are usually less obscure than those of Nature, and so (Bacon thinks) may give us a readier clue through the Efficient to the Formal.

ligatus, et quasi maleficiatus quoad illa; ita ut cum aliis consuescere non possit, sed cogitet nihil ejus generis fieri posse, nisi eadem via, qua illa effecta sunt, accedente tantummodo diligentia majore, et præparatione magis accurata.

Contra, illud ponendum est pro certo; vias et modos efficiendi res et opera, quæ adhuc reperta sunt et notata, res esse plerunque pauperculas, atque omnem potentiam majorem pendere et ordine derivari a fontibus formarum, quarum nulla adhuc inventa est[81].

Itaque (ut alibi diximus[82]) qui de machinis et arietibus, quales erant apud veteres, cogitasset; licet hoc fecisset obnixe, atque ætatem in eo consumpsisset; nunquam tamen incidisset in inventum tormentorum igneorum operantium per pulverem pyrium. Neque rursus, qui in lanificiis et serico vegetabili observationem suam et meditationem collocasset, unquam per ea reperisset naturam vermis aut serici bombycini.

Quocirca omnia inventa, quæ censeri possunt magis nobilia, (si animum advertas) in lucem prodiere, nullo modo per pusillas enucleationes et extensiones artium, sed omnino per casum. Nihil autem repræsentat aut anticipat casum, (cujus mos est, ut tantum per longa secula operetur) præter inventionem formarum.

Exempla autem hujusmodi instantiarum particularia nihil opus est adducere, propter copiam eorundem. Nam hoc omnino agendum, ut visitentur et penitus introspiciantur omnes artes mechanicæ, atque liberales

[81] Another evidence of Bacon's sanguine hopes for Human Power, after that his Method had put the almost divine knowledge of Forms within our reach.

[82] See supr. I. 109. This great influence of chance and circumstance upon Human Knowledge and Power is not less now than it was in Bacon's days. Witness the discovery of the power of Steam. What we have chiefly improved in is skill of application.

etiam, (quatenus ad opera) atque inde facienda est congeries sive historia particularis, tanquam magnalium, et operum magistralium, et maxime perfectorum in unaquaque ipsarum: una cum modis effectionis sive operationis.

Neque tamen astringimus diligentiam, quæ adhibenda est in hujusmodi collecta, ad ea, quæ censentur pro magisteriis et arcanis alicujus artis tantum, atque movent admirationem. Admiratio enim proles est raritàtis: siquidem rara, licet in genere sint ex vulgatis naturis, tamen admirationem pariunt.

At contra, quæ revera admirationi esse debent, propter discrepantiam, quæ inest illis in specie, collatis ad alias species; tamen si in usu familiari præsto sint, leviter notantur. Debent autem notari *monodica* artis, non minus quam *monodica* naturæ; de quibus antea diximus. Atque quemadmodum in *monodicis* naturæ posuimus solem, lunam, magnetem, et similia, quæ re vulgatissima sunt, sed natura tamen fere singulari: idem et de *monodicis* artis faciendum est.

Exempli gratia: instantia *monodica* artis, est papyrus; res admodum vulgata. At si diligenter animum advertas, materiæ artificiales aut plane textiles sunt per fila directa et transversa; qualia sunt pannus sericus, aut laneus, et linteus, et hujusmodi: aut coagmentantur ex succis concretis; qualia sunt later, aut argilla figularis, aut vitrum, aut esmalta[83], aut porcellana, et similia; quæ, si bene uniantur, splendent; sin minus, indurantur certe, sed non splendent. Attamen omnia talia, quæ fiunt ex succis concretis, sunt fragilia; nec ullo modo hærentia et tenacia. At contra, papyrus est corpus tenax, quod scindi et lacerari possit, ita ut

[83] *Esmalta*, Italian "smalto," "ismalto," enamel. The word is connected with the Anglo-Saxon "Myltan," to melt or smelt.

imitetur et fere æmuletur pellem sive membranam alicujus animalis, aut folium alicujus vegetabilis, et hujusmodo opificia naturæ. Nam neque fragilis est, ut vitrum; neque textilis, ut pannus; sed habet fibras certe, non fila distincta, omnino ad modum materiarum naturalium: ut inter artificiales materias vix inveniatur simile aliquid, sed sit plane *monodicum*. Atque præferenda sane sunt in artificialibus ea, quæ maxime accedunt ad imitationem naturæ, aut e contrario eam potenter regunt et invertunt.

Rursus, inter *ingenia* et *manus hominis*, non prorsus contemnenda sunt præstigiæ et jocularia. Nonnulla enim ex istis, licet sint usu levia et ludicra, tamen informatione valida esse possunt.

Postremo, neque omnino omittenda sunt superstitiosa, et (prout vocabulum sensu vulgari accipitur) magica[84]. Licet enim hujusmodi res sint in immensum obrutæ grandi mole mendaciorum et fabularum; tamen inspiciendum paulisper, si forte subsit et lateat in aliquibus earum aliqua operatio naturalis: ut in fascino; et fortificatione imaginationis; et consensu rerum ad distans; et transmissione impressionum a spiritu ad spiritum, non minus quam a corpore ad corpus[85]; et similibus.

[84] Bacon never shews himself without hopes even from tricks and magical sleight. See I. 85. He hoped after the discovery of Form, for a higher kind of *Magia* of which the ordinary Magic was a shadow. See supr. II. 9.

[85] These remarks might have been written of the Modern wonders of "Electrobiology," &c. which seem to be a certain fascination of the whole Nervous System, and of the Memory—without affecting the Will, perhaps; or at any rate only partially affecting it: and they may indicate a condition of Physical affections as yet but little noticed. The same is more perfectly, though less strikingly, seen in "Mesmeric" slumbers. (I do not mean in "Clairvoyance," or any such *præstigiæ;* but in the mere power of so affecting a person's Nervous System as to produce slumber.) It is strange that in our age we should return to the problem—of old so

XXXII.

Ex iis, quæ ante dicta sunt, patet; quod quinque illa instantiarum genera, de quibus diximus, (viz. *instantiarum conformium, instantiarum monodicarum, instantiarum deviantium, instantiarum limitanearum, instantiarum potestatis*) non debeant reservari, donec inquiratur natura aliqua certa (quemadmodum instantiæ reliquæ, quas primo loco proposuimus, nec non plurimæ ex iis, quæ sequentur, reservari debent); sed statim jam ab initio facienda est earum collectio, tanquam historia quædam particularis; eo quod digerant ea, quæ ingrediuntur intellectum, et corrigant pravam complexionem intellectus ipsius, quem omnino necesse est imbui et infici et demum perverti ac distorqueri ab incursibus quotidianis et consuetis [86].

Itaque adhibendæ sunt eæ instantiæ, tanquam præparativum aliquod, ad rectificandum et expurgandum intellectum. Quicquid enim abducit intellectum a consuetis, æquat et complanat aream ejus ad recipiendum lumen siccum et purum notionum verarum.

Quin etiam hujusmodi instantiæ sternunt et præstruunt viam ad operativam; ut suo loco dicemus, quando de *deductionibus ad praxin* sermo erit [87].

XXXIII.

Inter *prærogativas instantiarum* ponemus loco undecimo *instantias comitatus*, atque *hostiles;* quas etiam *instantias propositionum fixarum* appellare consuevimus [88]. Eæ sunt instantiæ, quæ exhibent aliquod cor-

common and so great a favourite—of the "transmissio impressionum a spiritu ad spiritum."

[86] It is very hard to see exactly why, if these last five kinds of Prerogative Instances are preliminary, they should be inserted in this place.

[87] See II. 21. *Deductiones ad Praxin* would have been the Seventh Head of the Auxilia Intellectus.

[88] These are cases in which cer-

pus sive concretum tale, in quo natura inquisita perpetuo sequatur tanquam comes quidam individuus: aut contra, in quo natura inquisita perpetuo fugiat, atque ex *comitatu* excludatur, ut hostis et inimicus. Nam ex hujusmodi instantiis formantur propositiones certæ et universales; aut *affirmativæ*, aut *negativæ:* in quibus subjectum erit tale corpus in concreto, prædicatum vero natura ipsa inquisita [89]. Etenim propositiones particulares omnino *fixæ* non sunt, ubi scilicet natura inquisita reperitur in aliquo concreto fluxa et mobilis; viz. accedens, sive acquisita; aut rursus recedens, sive deposita. Quocirca particulares propositiones non habent *prærogativam* aliquam majorem, nisi tantum in casu *migrationis;* de quo antea dictum est. Et nihilominus, etiam particulares illæ propositiones comparatæ et collatæ cum universalibus multum juvant; ut suo loco dicetur. Neque tamen, etiam in universalibus istis propositionibus exactam aut absolutam affirmationem vel abnegationem requirimus. Sufficit enim ad id quod agitur, etiamsi exceptionem nonnullam singularem aut raram patiantur.

Usus autem *instantiarum comitatus* est ad angustandam *affirmativam* formæ. Quemadmodum enim in *instantiis migrantibus* angustatur *affirmativa* formæ; viz. ut necessario poni debeat forma rei esse aliquid, quod per actum illum *migrationis* inditur aut destru-

tain qualities or properties always accompany each other, or are always disjoined. This "Prerogative Instance" is like the first, in having an Affirmative and a Negative side. Bacon sets this Class over against that of "Migrating Instances."

[89] It is worth while to notice how Bacon clings to the Logical Language of the Schools, against which he all the time protested. I suppose that these, his "Universal Propositions," which are so contrasted with "Particular Propositions." are only, in reality, more general statements embracing that which is common to many particulars. For they are (according to Bacon himself) still liable to the "Instantia Contradictoria," and so are to be regarded as "general" in the popular rather than in the scientific sense.

itur; ita etiam in *instantiis comitatus* angustatur *affirmativa* formæ; ut necessario poni debeat forma rei esse aliquid, quod talem concretionem corporis subingrediatur, aut contra ab eadem abhorreat; ut qui bene norit constitutionem aut schematismum hujusmodi corporis, non longe abfuerit ab extrahenda in lucem forma naturæ inquisitæ.

Exempli gratia; sit natura inquisita, calidum. *Instantia comitatus* est flamma[90]. Etenim in aqua, aëre, lapide, metallo, et aliis quamplurimis, calor est mobilis, et accedere potest et recedere: at omnis flamma est calida, ita ut calor in concretione flammæ perpetuo sequatur. At *instantia hostilis* calidi nulla reperitur apud nos. Nam de visceribus terræ nihil constat ad sensum; sed eorum corporum, quæ nobis nota sunt, nulla prorsus est concretio, quæ non est susceptibilis caloris.

At rursus, sit natura inquisita, consistens: *instantia hostilis* est aër. Etenim metallum potest fluere, potest consistere; similiter vitrum; etiam aqua potest consistere, cum conglaciatur: at impossibile est ut aër unquam consistat, aut exuat fluorem.

Verum de *instantiis* hujusmodi *propositionum fixarum* supersunt duo monita, quæ utilia sunt ad id quod agitur. Primum, ut si defuerit plane universalis *affirmativa* aut *negativa*, illud ipsum diligenter notetur tanquam non-ens[91]: sicut fecimus de calido, ubi universalis negativa (quatenus ad entia, quæ ad nostram

[90] "Body and Weight" would be a very good Instance of Accompaniment, and "Transparency and Malleability" of Hostility. Bacon's instance of "Air and Consistency" is of doubtful truth.

[91] Entia and non-entia—scholastic terms again. The first of these two *Monita* is also very scholastic in character—referring to the older speculations on things "celestial and terrestrial," which, properly speaking, Bacon has excluded from his Method.

notitiam pervenerint) in rerum natura deest. Similiter, si natura inquisita sit æternum, aut incorruptibile; deest affirmativa universalis hic apud nos. Neque enim prædicari potest *æternum* aut *incorruptibile* de aliquo corpore eorum, quæ infra cœlestia sunt, aut supra interiora terræ. Alterum monitum est, ut propositionibus universalibus tam affirmativis quam negativis de aliquo concreto, subjungantur[92] simul ea concreta, quæ proxime videntur accedere ad id quod est ex non-entibus: ut in calore, flammæ mollissimæ et minimum adurentes; in incorruptibili, aurum, quod proxime accedit. Omnia enim ista indicant terminos naturæ inter ens et non-ens; et faciunt ad circumscriptiones formarum, ne gliscant et vagentur extra conditiones materiæ[93].

XXXIV.

Inter *prærogativas instantiarum*, ponemus loco duodecimo ipsas illas *instantias subjunctivas*, de quibus in superiori aphorismo diximus: quas etiam *instantias ultimitatis* sive *termini* appellare consuevimus[94]. Ne-

[92] Cf. the commencement of the next Aphorism (34).

[93] *Forms* must be kept within the limits of the conditions of Matter. This is against the Platonic εἴδη χωριστά. These two Monita are embodied practically in the next Aphorism.

[94] These Instances are a kind of Appendix to the last Aphorism, and approach very nearly to the position of exceptions to it. So, he says, they are useful in shewing the *limits* of Fixed Propositions: as Gold is the highest limit of Weight (so Bacon says); and on the other hand, there are some flames (such as that of Spirit of Wine) which are almost imponderable: these would be extreme cases of "Body and Weight." Of course Bacon's illustrations are not accurate; for Platina is heavier than Gold; and there are less ponderable flames than that of Spirit of Wine. Nor is Iron ultimate in hardness—the Diamond surpasses it. Nor the Whale in bulk compared with some of the great Geological Monsters; nor Gunpowder, in expansive force, compared with Detonating Powders. The "Vermiculi cutis" too are not animal bodies, but only little vessels caused originally by the obstruction of the perspiration in the pores of the Skin. Cf. infra, II. 43. (note 52.)

que enim hujusmodi instantiæ utiles sunt tantum, quatenus subjunguntur propositionibus fixis; verum etiam per se, et in proprietate sua. Indicant enim non obscure veras sectiones naturæ, et mensuras rerum, et illud *quousque* natura quid faciat et ferat, et deinde transitus naturæ ad aliud. Talia sunt aurum, in pondere; ferrum, in duritie; cete, in quantitate animalium; canis, in odore; inflammatio pulveris pyrii, in expansione celeri; et alia id genus. Nec minus exhibenda sunt ea, quæ sunt ultima gradu infimo, quam quæ supremo: ut spiritus vini, in pondere; sericum, in mollitie; vermiculi cutis, in quantitate animalium; et cætera.

XXXV.

Inter *prærogativas instantiarum,* ponemus loco decimo tertio *instantias fœderis* sive *unionis*[95]. Eæ sunt, quæ confundunt et adunant naturas, quæ existimantur esse heterogeneæ; et pro talibus notantur et signantur per divisiones receptas.

At *instantiæ fœderis* ostendunt operationes et effectus, quæ deputantur alicui ex illis heterogeneis ut propria, competere etiam aliis ex heterogeneis; ut convincatur ista heterogenea (quæ in opinione est) vera non esse, aut essentialis; sed nil aliud esse, quam modificatio naturæ communis. Optimi itaque sunt

[95] Cases in which "Natures" supposed to be heterogeneous are found, by investigation of operations and effects, to be near to one another, and the dissimilarity is thereby proved to be untrue. These Instances help us in our search for *genera,* and are connected with the power of *Analogy* in our minds, not with that of seeing *Differences.* The Positive Philosopher may notice that he speaks of this Term *Fœdus* as "commune vinculum animi et corporis" in the De Augm. Scient. iv. 1, as though there was a similarity in kind between soul and body. See App. C.

The illustrations from popular belief in this Aphorism are very curious: Heat of three kinds, Motion, &c.

usus ad elevandum et evehendum intellectum a differentiis ad genera, et ad tollendum larvas et simulacra rerum, prout occurrunt et prodeunt personatæ in substantiis concretis.

Exempli gratia: sit natura inquisita, calidum. Omnino videtur esse divisio solennis et authentica, quod sint tria genera caloris: videlicet calor cœlestium, calor animalium, et calor ignis: quodque isti calores (præsertim unus ex illis, comparatus ad reliquos duos) sint ipsa essentia et specie, sive natura specifica, differentes et plane heterogenei: quandoquidem calor cœlestium et animalium generet et foveat, at calor ignis contra corrumpat et destruat. Est itaque *instantia fœderis* experimentum illud satis vulgatum, cum recipitur ramus aliquis vitis intra domum ubi sit focus assiduus, ex quo maturescunt uvæ etiam mense integro citius quam foras: ita ut maturatio fructus etiam pendentis super arborem fieri possit, scilicet ab igne, cum hoc ipsum videatur esse opus proprium solis. Itaque ab hoc initio facile insurgit intellectus, repudiata heterogenea essentiali, ad inquirendum quæ sint differentiæ illæ, quæ revera reperiuntur inter calorem solis et ignis, ex quibus fit, ut eorum operationes sint tam dissimiles, utcunque illi ipsi participent ex natura communi.

Quæ differentiæ reperientur quatuor: viz. primo, quod calor solis, respectu caloris ignis, sit gradu longe clementior et lenior: secundo, quod sit (præsertim ut defertur ad nos per aërem) qualitate multo humidior: tertio, (quod caput rei est) quod sit summe inæqualis, atque accedens et auctus, deinceps recedens et diminutus: id quod maxime confert ad generationem corporum. Recte enim asseruit Aristoteles causam principalem generationum et corruptionum, quæ fiunt hic

apud nos in superficie terræ, esse viam obliquam solis per zodiacum[96]: unde calor solis, partim per vicissitudines diei et noctis, partim per successiones æstatis et hyemis, evadit miris modis inæqualis. Neque tamen desinit ille vir id quod ab eo recte inventum fuit statim corrumpere et depravare. Nam ut arbiter scilicet naturæ (quod illi in more est) valde magistraliter assignat causam generationis accessui solis; causam autem corruptionis, recessui: cum utraque res (accessus videlicet solis, et recessus) non respective, sed quasi indifferenter præbeat causam tam generationi quam corruptioni: quandoquidem inæqualitas caloris, generationi et corruptioni rerum; æqualitas, conservationi tantum ministret. Est et quarta differentia inter calorem solis et ignis, magni prorsus momenti: viz. quod sol operationes suas insinuet per longa temporis spatia; ubi operationes ignis (urgente hominum impatientia) per breviora intervalla ad exitum perducantur. Quod si quis id sedulo agat, ut calorem ignis attemperet et reducat ad gradum moderatiorem et leniorem (quod multis modis facile fit); deinde etiam inspergat et admisceat nonnullam humiditatem; maxime autem si imitetur calorem solis in inæqualitate; postremo, si moram patienter toleret, (non certe eam, quæ sit proportionata operibus solis, sed largiorem, quam homines adhibere solent in operibus ignis;) is facile missam faciet heterogeneam illam caloris: et vel tentabit, vel exæquabit, vel in aliquibus vincet opera solis, per calorem ignis. Similis *instantia fœderis* est resuscitatio papilionum ex frigore stupentium et tanquam emortuorum, per exiguum teporem ignis: ut facile cernas,

[96] Arist. de Gen. et Corr. lib. II. cap. 9. οὐχ ἡ πρώτη φορὰ αἰτία ἐστὶ γενέσεως καὶ φθορᾶς, ἀλλ' ἡ κατὰ τὸν λοξὸν κύκλον. By this λοξὸς κύκλος Aristotle means the Ecliptic.

non magis negatum esse igni, vivificare animantia, quam maturare vegetabilia. Etiam inventum illud celebre Fracastorii[97] de sartagine acriter calefacta, qua circundant medici capita apoplecticorum desperatorum, expandit manifeste spiritus animales, ab humoribus et obstructionibus cerebri compressos et quasi extinctos; illosque ad motum excitat, non aliter quam ignis operatur in aquam aut aërem; et tamen per consequens vivificat. Etiam ova aliquando excluduntur per calorem ignis; id quod prorsus imitatur calorem animalem: et complura ejusmodi: ut nemo dubitare possit, quin calor ignis in multis subjectis modificari possit ad imaginem caloris cœlestium et animalium.

Similiter sint naturæ inquisitæ, motus et quies[98]. Videtur esse divisio solennis atque ex intima philosophia, quod corpora naturalia vel rotent, vel ferantur recta, vel stent sive quiescant. Aut enim est motus sine termino, aut statio in termino, aut latio ad terminum. At motus ille perennis rotationis, videtur esse cœlestium proprius; statio, sive quies, videtur competere globo ipsi terræ: at corpora cætera (gravia quæ vocant, et levia) extra loca scilicet connaturalitatis suæ sita, feruntur recta ad massas sive congregationes similium; levia sursum, versus ambitum cœli; gravia deorsum, versus terram. Atque ista pulchra dictu sunt.

At *instantia fœderis* est cometa aliquis humilior[99];

[97] *Fracastorius*, cf. infr. II. 36. case 6. Girolamo Fracastoro was born at Verona in 1483. He was a distinguished Philosopher, Astronomer, Physician, and Poet, and wrote on the Morbus Gallicus, on "Sympathia et Antipathia," on "Contagion and Contagious Diseases." Died in 1553.

[98] It is melancholy that Bacon should have written all this after Kepler's Laws had become well known, if indeed he believed it.

[99] Comets are (though not in the way in which Bacon thought) excellent examples of the Inst. Fœderis. For their apparently erratic orbits are really as strictly subjected to the Laws of Gravity as any other orbits. But of course this was unknown in Bacon's day.

qui cum sit longe infra cœlum, tamen rotat. Atque commentum Aristotelis, de alligatione sive sequacitate cometæ ad astrum aliquod, jampridem explosum est; non tantum quia ratio ejus non est probabilis, sed propter experientiam manifestam discursus et irregularis motus cometarum per varia loca cœli.

At rursus alia *instantia fœderis*, circa hoc subjectum, est motus aëris; qui intra tropicos (ubi circuli rotationis sunt majores) videtur et ipse rotare ab oriente in occidentem.

Et alia rursus *instantia* foret fluxus et refluxus[100] maris, si modo aquæ ipsæ deprehendantur ferri motu rotationis (licet tardo et evanido) ab oriente in occidentem; ita tamen, ut bis in die repercutiantur. Itaque si hæc ita se habeant, manifestum est, motum istum rotationis non terminari in cœlestibus, sed communicari aëri et aquæ.

Etiam ista proprietas levium, nimirum ut ferantur sursum, vacillat nonnihil[1]. Atque in hoc sumi potest pro *instantia fœderis* bulla aquæ. Si enim aër fuerit subter aquam, ascendit rapide versus superficiem aquæ, per motum illum *plagæ*, (quam vocat Democritus[2]) per quam aqua descendens percutit et attollit aërem sursum; non autem per contentionem aut nixum aëris ipsius. Atque ubi ad superficiem ipsam aquæ ventum fuerit, tum cohibetur aër ab ulteriore ascensu per levem resistentiam, quam reperit in aqua non statim tolerante se discontinuari: ita ut exilis admodum sit appetitus aëris ad superiora.

[100] For the Theory of the Tides at greater length, see II. 36. case i.

[1] This speculation, too, has become perfectly useless, since Newton's discoveries on Gravitation.

[2] These πληγαὶ of Democritus, fanciful and unfounded as they are, are not altogether abandoned by Bacon. He felt a great liking for that Philosopher, as indeed he did for all before the Socratic period. Cf. infr. II. 48. (motus 3.)

Similiter sit natura inquisita, pondus. Est plane divisio recepta; ut densa et solida ferantur versus centrum terræ, rara autem et tenuia versus ambitum cœli; tanquam ad loca sua propria. Atque loca quod attinet (licet in scholis hujusmodi res valeant) plane inepta et puerilis cogitatio est, locum aliquid posse. Itaque nugantur philosophi, cum dicunt, quod, si perforata esset terra, corpora gravia se sisterent quando ventum esset ad centrum. Esset enim certe virtuosum plane et efficax genus nihili, aut puncti mathematici[3]; quod aut alia afficeret, aut rursus quod alia appeterent: corpus enim non nisi a corpore patitur. Verum iste appetitus ascendendi et descendendi, aut est in schematismo corporis quod movetur, aut in sympathia sive consensu cum alio corpore. Quod si inveniatur aliquod corpus densum et solidum, quod nihilominus non feratur ad terram; confunditur hujusmodi divisio. At si recipiatur opinio Gilberti[4], quod magnetica vis terræ ad alliciendum gravia, non extendatur ultra orbem virtutis suæ, (quæ operatur semper ad distantiam certam, et non ultra,) hocque per aliquam instantiam verificetur; ea demum erit *instantia fœderis* circa hoc subjectum. Neque tamen occurrit impræsentiarum aliqua instantia super hoc certa et manifesta. Proxime videntur accedere cataractæ cœli, quæ in navigationibus per oceanum Atlanticum versus Indias utrasque sæpe conspiciuntur. Tanta enim videtur esse vis et moles aquarum, quæ per hujusmodi cataractas subito effunditur, ut videatur

[3] This is curious, and to us almost ludicrous language. But we must remember Seneca's "Veniet tempus, quo posteri nostri tam aperta nos nesciisse mirentur"—and that our better information is the "partus temporis non ingenii." The ancient notion of Absolute Levity, referred to just above, is to be found in Aristotle, Phys. Ausc. IV. v. 13.

[4] Gilbert is here mentioned almost with respect. Cf. supr. I. 54.

collectio aquarum fuisse ante facta, atque in his locis hæsisse et mansisse, et postea potius per causam violentam dejecta et detrusa esse, quam naturali motu gravitatis cecidisse: adeo ut conjici possit corpoream molem densam atque compactam in magna distantia a terra fore pensilem tanquam terram ipsam; nec casuram, nisi dejiciatur. Verum de hoc nil certi affirmamus. Interim in hoc et in multis aliis facile apparebit, quam inopes simus historiæ naturalis; cum loco instantiarum certarum nonnunquam suppositiones afferre pro exemplis cogamur.

Similiter sit natura inquisita, discursus ingenii. Videtur omnino divisio vera, rationis humanæ, et solertiæ brutorum[5]. Attamen sunt nonnullæ instantiæ actionum, quæ eduntur a brutis, per quas videntur etiam bruta quasi syllogizare: ut memoriæ proditum est de corvo; qui per magnas siccitates fere enectus siti, conspexit aquam in trunco cavo arboris; atque cum non daretur ei intrare propter angustias, non cessavit jacere multos lapillos, per quos surgeret et ascenderet aqua, ut bibere posset; quod postea cessit in proverbium.

Similiter sit natura inquisita, visibile. Videtur om-

[5] They who allow man no higher "Differentia" than the scholastic "Rationale"—who regard the inferential power as the distinctive quality of Humanity—must always tremble at any glimmering of a Syllogistic faculty in Brutes, and fear lest, after all, man should be nothing more than a highly polished Ape. Yet even then the gift of speech (μερόπων γένος ἀνδρῶν) would do much to distinguish us from our unpleasant neighbours in the scale of Creation: though here too we approach a little too near to Parrots. But, in truth, Man's Differentia lies in no *one* quality, and certainly not most in his *Intellectual* superiority. His "Spiritual" faculties raise him highest. His Moral and Social qualities, and his power of combination, all lift him above other creatures; and though some slight growth and improvement may be discerned in the mental powers (if one may be pardoned for such language) of domesticated beasts, yet Man alone is really progressive—alone can consciously use the knowledge of his fathers as means for the increase of his own.

nino esse divisio vera et certa, lucis, quæ est visibile originale, et primam copiam facit visui; et coloris, qui est visibile secundarium, et sine luce non cernitur, ita ut videatur nil aliud esse quam imago aut modificatio lucis. Attamen ex utraque parte circa hoc videntur esse *instantiæ fœderis*; scilicet, nix in magna quantitate, et flamma sulphuris: in quarum altera videtur esse color primulum lucens, in altera lux vergens ad colorem.

XXXVI.

Inter prærogativas instantiarum ponemus loco decimo quarto *instantias crucis*; translato vocabulo a *crucibus*, quæ, erectæ in biviis, indicant et signant viarum separationes[6]. Has etiam *instantias decisorias*, et

[6] Instances of the Cross, or Crucial Instances, are the most famous of all, and of the greatest value in Physical Investigation. "They afford the readiest and securest means of eliminating extraneous causes, and deciding between rival Hypotheses." Herschel's Discourse, § 196. "When," says Playfair, Diss. iii. p. 465, "in investigation, the understanding is placed *in equilibrio*, as it were, between two or more causes, each of which accounts equally well for the appearances, as far as they are known, nothing remains but to look out for a fact which can be explained by one of these causes, and not by the other: if such an one can be found, the uncertainty is removed, and the true cause determined." Chemistry is full of these Instances. Playfair gives the famous illustration of the escape of "Phlogiston" or "Absolute levity" from metals when calcined. As it was seen that, when calcined, metals weighed more than they did before the application of Heat, it was necessary to account for the fact. There would be two theories: (1) that of Phlogiston—the escape of "absolute levity." (2) The introduction of some new chemical compound. Lavoisier exploded the Phlogistic theory by a Crucial Instance. He took a quantity of Tin, sealed it hermetically in a glass retort, and then weighed the glass with its contents. Then he calcined the metal, and weighed the glass again. It was found to have suffered no change of weight. When it was cool, the retort was opened, and air rushed in, shewing that a partial vacuum had been created. The glass was then weighed a third time, and it had now gained ten grains; i. e. ten grains of air had rushed in. The calcined Tin was then taken out, and was found to be ten grains heavier than before the application of fire. These ten grains had, therefore, been absorbed from the air. This experiment led to the discovery of Oxygen Gas,

judiciales, et in casibus nonnullis *instantias oraculi*, et *mandati*, appellare consuevimus. Earum ratio talis est. Cum in inquisitione naturæ alicujus, intellectus ponitur tanquam in æquilibrio, ut incertus sit, utri naturarum e duabus, vel quandoque pluribus, causa naturæ inquisitæ attribui aut assignari debeat, propter complurium naturarum concursum frequentem et ordinarium; *instantiæ crucis* ostendunt consortium unius ex naturis (quoad naturam inquisitam) fidum et indissolubile, alterius autem varium et separabile; unde terminatur quæstio, et recipitur natura illa prior pro causa, missa altera et repudiata. Itaque hujusmodi instantiæ sunt maximæ lucis, et quasi magnæ auctoritatis; ita ut curriculum interpretationis quandoque in illas desinat, et per illas perficiatur. Interdum autem *instantiæ crucis* illæ occurrunt et inveniuntur inter jampridem notatas; at ut plurimum novæ sunt, et de industria atque ex composito quæsitæ et applicatæ, et diligentia sedula et acri tandem erutæ.

(1.) Exempli gratia; sit natura inquisita fluxus et refluxus maris[7] ille bis repetitus in die atque sexhorarius, in accessibus et recessibus singulis, cum differentia nonnulla quæ coincidit in motum lunæ: bivium circa hanc naturam tale est.

and of its property of combining with metals when they are calcined. Account of the Nov. Org. published in the Library of Useful Knowledge, part ii. p. 21. For another good illustration, viz. the Torricellian discoveries of the pressure of the air, see Herschel's Discourse, § 246.

[7] The Tides. There is a disquisition on them, placed by Gruter among Bacon's Materials for the IIIrd part of the Instauration. The Tides are a corollary of the great law of Attraction, which was hidden from Bacon's sight. And yet his language on "vis magnetica desuper eas" looks as if he were groping about in the right direction. Tides are really nothing but the great Primary Wave, which, in obedience to lunar attraction (and at certain stated periods) lunar and solar attractions together, rises and sinks in the Ocean. There are Tides in the Air to correspond to those in the Ocean; and from the same causes. For Bacon's guesses in the right direction, see inf. II. 45.

Necesse prorsus est, ut iste motus efficiatur, vel ab aquarum progressu et regressu, in modum aquæ in pelvi agitatæ, quæ quando latus unum pelvis alluit, deserit alterum; vel a sublatione et subsidentia aquarum e profundo, in modum aquæ ebullientis, et rursus subsidentis: utri vero causæ fluxus et refluxus ille assignari debeat, oritur dubitatio. Quod si recipiatur prior assertio, necesse est ut cum sit fluxus in mari ex una parte, fiat sub idem tempus alicubi in mari refluxus ex alia. Itaque ad hoc reducitur inquisitio. Atqui observavit Acosta, cum aliis nonnullis (diligenti facta inquisitione) quod ad litora Floridæ, et ad litora adversa Hispaniæ et Africæ, fiant fluxus maris ad eadem tempora, et refluxus itidem ad eadem tempora; non contra, quod cum fluxus fit ad litora Floridæ, fiat refluxus ad litora Hispaniæ et Africæ. Attamen adhuc diligentius attendenti, non per hoc evincitur motus attollens, et abnegatur motus in progressu. Fieri enim potest, quod sit motus aquarum in progressu, et nihilominus inundet adversa litora ejusdem alvei simul; si aquæ scilicet illæ contrudantur et compellantur aliunde; quemadmodum fit in fluviis, qui fluunt et refluunt ad utrumque litus horis iisdem, cum tamen iste motus liquido sit motus in progressu, nempe aquarum ingredientium ostia fluminum ex mari. Itaque simili modo fieri potest, ut aquæ venientes magna mole ab oceano orientali Indico compellantur et trudantur in alveum maris Atlantici, et propterea inundent utrumque latus simul. Quærendum itaque est, an sit alius alveus, per quem aquæ possint iisdem temporibus minui et refluere. Atque præsto est mare Australe, mari Atlantico neutiquam minus, sed potius magis latum et extensum, quod ad hoc sufficere possit.

Itaque jam tandem perventum est ad *instantiam*

crucis circa hoc subjectum. Ea talis est. Si pro certo inveniatur, quod cum fit fluxus ad litora adversa tam Floridæ quam Hispaniæ in mari Atlantico, fiat simul fluxus ad litora Peruviæ[8], et juxta dorsum Chinæ in mari Australi; tum certe per hanc *instantiam decisoriam* abjudicanda est assertio, quod fluxus et refluxus maris, de quo inquiritur, fiat per motum progressivum. Neque enim relinquitur aliud mare, aut locus, ubi possit ad eadem tempora fieri regressus, aut refluxus. Commodissime autem hoc sciri possit, si inquiratur ab incolis Panamæ, et Limæ, (ubi uterque oceanus, Atlanticus et Australis, per parvum isthmum separantur) utrum ad contrarias isthmi partes fiat simul fluxus et refluxus maris, an e contra. Verum hæc decisio, sive abjudicatio certa videtur, posito quod terra stet immobilis. Quod si terra rotet, fieri fortasse potest, ut ex inæquali rotatione (quatenus ad celeritatem sive incitationem) terræ, et aquarum maris, sequatur compulsio violenta aquarum in cumulum sursum, quæ sit fluxus; et relaxatio earundem (postquam amplius cumulari non sustinuerint) in deorsum, quæ sit refluxus[9]. Verum de hoc facienda est inquisitio separatim. Attamen etiam hoc supposito, illud æque manet fixum, quod necesse sit fieri alicubi refluxum maris ad eadem tempora, quibus fiunt fluxus in aliis partibus.

Similiter, sit natura inquisita, posterior ille motus ex duobus, quos supposuimus; videlicet motus maris se attollens, et rursus subsidens; si forte ita acciderit, ut (diligenti facto examine) rejiciatur motus alter, de quo

[8] By Peru, Bacon seemed to include the chief part of South America on the Eastern Coast. Cf. supra, II. 27. And the Mare Australe here is not our modern Southern Ocean, but the Southern and the Pacific Oceans.

[9] The Rotation of the Earth causes the great currents in the Ocean—the Polar current and the Gulf stream: and also the Trade winds in the air, but not the Tides.

diximus, progressivus. Tum vero erit trivium circa hanc naturam tale. Necesse est, ut motus iste, per quem aquæ in fluxibus et refluxibus se attollunt, et rursus relabuntur, absque aliqua accessione aquarum aliarum, quæ advolvuntur, fiat per unum ex his tribus modis; vel quod ista aquarum copia emanet ex interioribus terræ, et rursus in illa se recipiat; vel quod non sit aliqua amplior moles aquarum, sed quod eædem aquæ (non aucto quanto suo) extendantur, sive rarefiant, ita ut majorem locum et dimensionem occupent, et rursus se contrahant; vel quod nec copia accedat major, nec extensio amplior, sed eædem aquæ (prout sunt, tam copia quam densitate aut raritate) per vim aliquam magneticam desuper eas attrahentem, et evocantem, et per consensum se attollant, et deinde se remittant. Itaque reducatur (si placet) jam inquisitio (missis duobus illis motibus prioribus) ad hunc ultimum; et inquiratur si fiat aliqua talis sublatio per consensum, sive vim magneticam. Atqui primo manifestum est, universas aquas, prout ponuntur in fossa sive cavo maris, non posse simul attolli, quia deesset quod succederet in fundo; adeo ut si foret in aquis aliquis hujusmodi appetitus se attollendi, ille ipse tamen a nexu rerum, sive (ut vulgo loquuntur) ne detur vacuum, fractus foret et cohibitus. Relinquitur, ut attollantur aquæ ex aliqua parte, et per hoc minuantur et cedant ex alia. Enimvero rursus necessario sequetur, ut vis illa magnetica, cum super totum operari non possit, circa medium operetur intensissime, ita ut aquas in medio attollat; illæ vero sublatæ, latera per successionem deserant et destituant.

Itaque jam tandem perventum est ad *instantiam crucis* circa hoc subjectum. Ea talis est. Si inveniatur, quod in refluxibus maris aquarum superficies in

mari sit arcuata magis et rotunda, attollentibus se scilicet aquis in medio maris, et deficientibus circa latera, quæ sunt litora; et in fluxibus eadem superficies sit magis plana et æqua, redeuntibus scilicet aquis ad priorem suam positionem; tum certe per hanc *instantiam decisoriam* potest recipi sublatio per vim magneticam; aliter prorsus abjudicanda est. Hoc vero in fretis per lineas nauticas non difficile est experiri; videlicet utrum in refluxibus versus medium maris mare non sit magis altum sive profundum, quam in fluxibus. Notandum autem est, si hoc ita sit, fieri (contra ac creditur) ut attollant se aquæ in refluxibus, demittant se tantum in fluxibus, ita ut litora vestiant et inundent.

(2.) Similiter, sit natura inquisita, motus rotationis spontaneus[10]; et speciatim, utrum motus diurnus, per quem sol et stellæ ad conspectum nostrum oriuntur et occidunt, sit motus rotationis verus in cœlestibus; aut motus apparens in cœlestibus, verus in terra. Poterit esse *instantia crucis* super hoc subjectum talis. Si inveniatur motus aliquis in oceano ab oriente in occidentem, licet admodum languidus et enervatus: si idem motus reperiatur paulo incitatior in aëre, præsertim intra tropicos, ubi propter majores circulos est magis perceptibilis: si idem motus reperiatur in humilioribus cometis, jam factus vivus et validus: si idem motus reperiatur in planetis, ita tamen dispensatus et graduatus, ut quo propius absit a terra, sit tardior; quo longius, celerior; atque in cœlo demum stellato[11] sit

[10] Cf. supr. II. 5. (ad fin.) We need say no more about this exploded doctrine, than that in spite of the apology to be made for Bacon (see note to II. 5.), he was to some degree culpable for ranking Copernicus with the old Astronomers; for neglecting Galileo; and apparently for being ignorant of Kepler's Laws.

[11] Bacon had a strong liking for the doctrine of concentric circles, with Terra for a centre point: in the outermost of which circles he

velocissimus: tum certe recipi debet motus diurnus pro vero in cœlis, et abnegandus est motus terræ; quia manifestum erit, motum ab oriente in occidentem esse plane cosmicum, et ex consensu universi, qui, in summitatibus cœli maxime rapidus, gradatim labascat, et tandem desinat, et extinguatur in immobili, videlicet terra.

Similiter, sit natura inquisita, motus rotationis ille alter apud astronomos decantatus, renitens et contrarius motui diurno, videlicet ab occidente in orientem, quem veteres astronomi attribuunt planetis, etiam cœlo stellato; at Copernicus, et ejus sectatores, terræ quoque; et quæratur, utrum inveniatur in rerum natura aliquis talis motus, an potius res conficta sit et supposita, ad compendia et commoditates calculationum, et ad pulchrum illud, scilicet de expediendis motibus cœlestibus per circulos perfectos. Neutiquam enim evincitur iste motus esse in supernis verus et realis, nec per defectum restitutionis planetæ in motu diurno ad idem punctum cœli stellati, nec per diversam politatem zodiaci, habito respectu ad polos mundi; quæ duo nobis hunc motum pepererunt. Primum enim phænomenon per anteversionem et derelictionem optime salvatur; secundum per lineas spirales; adeo ut inæqualitas restitutionis, et declinatio ad tropicos, possint esse potius modificationes motus unici illius diurni, quam motus renitentes, aut circa diversos polos. Et certissimum est, si paulisper pro plebeiis nos geramus[12], (missis astronomorum et scholæ commentis, quibus illud in more est, ut sensui in multis immerito

placed the "Starry Heavens." He also divides (in connection with the same theory) Comets into higher and lower. (See below, note 20.)

[12] This looks very like an appeal to the vulgar and the unassisted senses. Are these not Idola as fatal as any he has pointed out?

vim faciant, et obscuriora malint) talem esse motum istum ad sensum, qualem diximus: cujus imaginem per fila ferrea (veluti in machina) aliquando repræsentari fecimus.

Verum *instantia crucis* super hoc subjectum poterit esse talis. Si inveniatur in aliqua historia fide digna, fuisse cometam aliquem, vel sublimiorem, vel humiliorem, qui non rotaverit cum consensu manifesto (licet admodum irregulariter) motus diurni, sed potius rotaverit in contrarium cœli; tum certe hucusque judicandum est, posse esse in natura aliquem talem motum. Sin nihil hujusmodi inveniatur, habendus est pro suspecto, et ad alias *instantias crucis* circa hoc confugiendum.

(3.) Similiter, sit natura inquisita, pondus sive grave[13]. Bivium circa hanc naturam tale est. Necesse est, ut gravia et ponderosa vel tendant ex natura sua ad centrum terræ, per proprium schematismum; vel ut a massa corporea ipsius terræ, tanquam a congregatione corporum connaturalium, attrahantur et rapiantur, et ad eam per consensum ferantur. At posterius hoc si in causa sit, sequitur, ut quo propius gravia appropinquant ad terram, eo fortius et majore cum impetu ferantur ad eam; quo longius ab ea absint, debilius et tardius, (ut fit in attractionibus magneticis) idque fieri intra spatium certum; adeo ut si elongata fuerint a terra tali distantia, ut virtus terræ in ea agere non possit, pensilia mansura sint, ut et ipsa terra, nec omnino decasura.

Itaque talis circa hanc rem poterit esse *instantia*

[13] Gravity. As far as his knowledge went, Bacon's notions as to gravity are good. His language about the "virtus terræ" and its limits; and the way in which bodies would become "pensilia," is curious.

crucis. Sumatur horologium[14] ex iis, quæ moventur per pondera plumbea; et aliud ex iis, quæ moventur per compressionem laminæ ferreæ; atque vere probentur, ne alterum altero velocius sit, aut tardius; deinde ponatur horologium illud movens per pondera super fastigium alicujus templi altissimi, altero illo infra detento; et notetur diligenter, si horologium in alto situm tardius moveatur quam solebat, propter diminutam virtutem ponderum. Idem fiat experimentum in profundis minerarum alte sub terra depressarum; utrum horologium hujusmodi non moveatur velocius quam solebat, propter auctam virtutem ponderum. Quod si inveniatur virtus ponderum minui in sublimi, aggravari in subterraneis; recipiatur pro causa ponderis attractio a massa corporea terræ.

(4.) Similiter, sit natura inquisita, verticitas acus ferreæ, tactæ magnete[15]. Circa hanc naturam tale erit bivium. Necesse est, ut tactus magnetis vel ex se indat ferro verticitatem ad septentriones et austrum; vel ut excitet ferrum tantummodo et habilitet: motus autem ipse indatur ex præsentia terræ, ut Gilbertus opinatur, et tanto conatu probare nititur. Itaque huc spectant ea, quæ ille perspicaci industria conquisivit. Nimirum quod clavus ferreus, qui diu duravit in situ versus septentriones et austrum, colligat mora diutina verticitatem, absque tactu magnetis: ac si terra ipsa, quæ ob distantiam debiliter operatur, (namque super-

[14] This example will not do. The "Horologium," or fly-clock, would act well enough were the earth stationary, and were there no other active force. Besides, the gravity at the bottom of a mine would be less: both because of the actual diminution, and of the mass of matter now placed above the point, which before attracted downwards, and now upwards.

[15] The Polarity of the Needle. This section is ingenious. We here meet Gilbert again. It was with such a "terrella," or little globe, as Bacon here proposes to use, that Gilbert made his experiments. See supr. I. 54.

ficies aut extima incrustatio terræ virtutis magneticæ, ut ille vult, expers est) per moram tamen longam magnetis tactum suppleret, et ferrum exciret, deinde excitum conformaret et verteret. Rursus, quod ferrum ignitum et candens, si in extinctione sua exporrigatur inter septentriones et austrum, colligat quoque verticitatem, absque tactu magnetis: ac si partes ferri in motu positæ per ignitionem, et postea se recipientes, in ipso articulo extinctionis suæ magis essent susceptivæ, et quasi sensitivæ virtutis manantis a terra, quam alias, et inde fierent tanquam excitæ. Verum hæc, licet bene observata, tamen non evincunt prorsus quod ille asserit.

Instantia crucis autem circa hoc subjectum poterit esse talis. Capiatur terrella ex magnete, et notentur poli ejus; et ponantur poli terrellæ versus orientem et occasum, non versus septentriones et austrum, atque ita jaceant: deinde superponatur acus ferrea intacta, et permittatur ita manere ad dies sex aut septem. Acus vero (nam de hoc non dubitatur) dum manet super magnetem, relictis polis mundi, se vertet ad polos magnetis. Itaque quamdiu ita manet, vertitur scilicet ad orientem et occidentem mundi. Quod si inveniatur acus illa remota a magnete, et posita super versorium, statim se applicare ad septentriones et austrum, vel etiam paulatim se eo recipere; tum recipienda est pro causa, præsentia terræ: sin autem vertatur (ut prius) in orientem et occidentem, aut perdat verticitatem, habenda est illa causa pro suspecta, et ulterius inquirendum est.

(5.) Similiter, sit natura inquisita, corporea substantia lunæ[16]; an sit tenuis, flammea, sive aërea, ut plurimi

[16] The structure of the Moon. Bacon seems to incline to the view that it is "tenuis," and not solid: perhaps in antagonism to Gilbert

ex priscis philosophis opinati sunt; an solida et densa, ut Gilbertus et multi moderni, cum nonnullis ex antiquis, tenent. Rationes posterioris istius opinionis fundantur in hoc maxime, quod luna radios solis reflectat; neque videtur fieri reflexio lucis nisi a solidis.

Itaque *instantiæ crucis* circa hoc subjectum eæ esse poterunt (si modo aliquæ sint) quæ demonstrent reflexionem a corpore tenui, qualis est flamma, modo sit crassitiei sufficientis. Certe causa crepusculi, inter alias, est reflexio radiorum solis a superiore parte aëris [17]. Etiam quandoque reflecti videmus radios solis temporibus vespertinis serenis, a fimbriis nubium roscidarum, non minori splendore, sed potius illustriori, et magis glorioso, quam qui redditur a corpore lunæ; neque tamen constat, eas nubes coaluisse in corpus densum aquæ. Etiam videmus, aërem tenebrosum pone fenestras noctu reflectere lucem candelæ, non minus quam corpus densum [18]. Tentandum etiam foret experimentum immissionis radiorum solis per foramen, super flammam aliquam subfuscam et cæruleam. Sane radii aperti solis, incidentes in flammas obscuriores, videntur eas quasi mortificare, ut conspiciantur magis instar fumi albi, quam flammæ. Atque hæc impræsentiarum occurrunt, quæ sint ex natura *instantiarum crucis* circa hanc rem; et meliora fortasse reperiri possunt. Sed notandum semper est, reflexionem a flamma non

and the new school. Their proof of its solidity was not of much value. But this signifies little now that we are able to calculate accurately the density, not only of the Moon, but even of the most distant Planets.

[17] True enough, if we add the *Refraction* of rays. The blueness of the air arises from the watery particles in it: and the light thus reflected from the sky is polarised: so that the fact of "Reflexio a corpore tenui" is fully established.

[18] Bacon's reason for this phenomenon is wrong. It is really the polished surface of the glass which reflects the rays: and this is always the case, but is only visible to us when there is neither light nor object on the other side to destroy the image created.

esse expectandam, nisi a flamma alicujus profunditatis: nam aliter vergit ad diaphanum. Hoc autem pro certo ponendum, lucem semper in corpore æquali aut excipi et transmitti, aut resilire.

(6.) Similiter, sit natura inquisita, motus missilium[19]; veluti spiculorum, sagittarum, globulorum, per aërem. Hunc motum schola (more suo) valde negligenter expedit; satis habens, si eum nomine motus violenti a naturali (quem vocant) distinguat; et quod ad primam percussionem sive impulsionem attinet, per illud (quod *duo corpora non possint esse in uno loco, ne fiat penetratio dimensionum*) sibi satisfaciat; et de processu continuato istius motus nihil curet. At circa hanc naturam bivium est tale: aut iste motus fit ab aëre vehente, et pone corpus emissum se colligente, instar fluvii erga scapham, aut venti erga paleas; aut a partibus ipsius corporis non sustinentibus impressionem, sed ad eandem laxandam per successionem se promoventibus. Atque priorem illum recipit Fracastorius[20], et fere omnes qui de hoc motu paulo subtilius inquisiverunt: neque dubium est, quin sint aëris partes in hac re nonnullæ; sed alter motus proculdubio verus est, ut ex infinitis constat experimentis. Sed inter cæteras, poterit esse circa hoc subjectum *instantia crucis* talis; quod lamina, aut filum ferri paulo contumacius, vel etiam calamus sive penna in medio divisa, adducta et

19 The motion of missiles.—"Schola" here probably means all existing Philosophers, with the exception of Bacon. This "motus missilium" is now safely housed as a branch of Dynamical Science; and all discussions as to Violent and Natural Motion, &c. are at an end.

20 Cf. supra, II. 35. (note 97.) Fracastoro's views were violently opposed to the Copernican hypothesis; and he wrote a book, entitled Homocentrica, to simplify that explanation of heavenly Phenomena, which made Earth the centre-point of the system, and placed the planets one after another, and finally the "Cœlum Stellatum," in fixed orbits of æther, all concentric in the earth. See Drinkwater's Life of Galileo, p. 13.

curvata inter pollicem et digitum, exsiliant. Manifestum enim est, hoc non posse imputari aëri se pone corpus colligenti, quia fons motus est in medio laminæ vel calami, non in extremis.

(7.) Similiter, sit natura inquisita, motus ille rapidus et potens expansionis pulveris pyrii in flammam[21]: unde tantæ moles subvertuntur, tanta pondera emittuntur, quanta in cuniculis majoribus, et bombardis videmus. Bivium circa hanc naturam tale est. Aut excitatur iste motus a mero corporis appetitu se dilatandi, postquam fuerit inflammatum; aut ab appetitu mixto spiritus crudi, qui rapide fugit ignem, et ex eo circumfuso, tanquam ex carcere, violenter erumpit. Schola autem, et vulgaris opinio tantum versatur circa priorem illum appetitum. Putant enim homines, se pulchre philosophari, si asserant, flammam ex forma elementi necessitate quadam donari locum ampliorem occupandi, quam idem corpus expleverat, cum subiret formam pulveris, atque inde sequi motum istum. Interim minime advertunt, licet hoc verum sit, posito quod flamma generetur, tamen posse impediri flammæ generationem a tanta mole, quæ illam comprimere et suffocare queat; ut non deducatur res ad istam necessitatem, de qua loquuntur. Nam quod necesse sit fieri expansionem, atque inde sequi emissionem, aut remotionem corporis quod obstat, si generetur flamma, recte

[21] The explosive power of Gunpowder. Here Bacon's language is again tinged with the old Scholastic manner of expression, "crudus Spiritus, qui est in Nitro." His way of accounting for it is absolutely wrong, except in so far as Charcoal is the connecting link between Saltpetre and Sulphur. He enlarges on his explanation in his "Cogitationes de Natura Rerum," chap. 9, which is a part of the fragments of the Third Part of the Instauratio. Milton illustrates the language of the Schools. Par. Lost, vi. 478.

"Materials dark and crude
Of spirituous and nitrous spume."

Nitre is the base of many violent detonating substances.

putant. Sed ista necessitas plane evitatur, si moles illa solida flammam supprimat, antequam generetur. Atque videmus, flammam, præsertim in prima generatione, mollem esse et lenem, et requirere cavum, in quo experiri et ludere possit. Itaque tanta violentia huic rei per se assignari non potest. Sed illud verum; generationem hujusmodi flammarum flatulentarum, et veluti ventorum igneorum, fieri ex conflictu duorum corporum, eorumque naturæ inter se plane contrariæ; alterius admodum inflammabilis, quæ natura viget in sulphure; alterius flámmam exhorrentis, qualis est spiritus crudus, qui est in nitro; adeo ut fiat conflictus mirabilis, inflammante se sulphure quantum potest, (nam tertium corpus, nimirum carbo salicis, nil aliud fere præstat, quam ut illa duo corpora incorporet, et commode uniat) et erumpente spiritu nitri quantum potest, et una se dilatante, (nam hoc faciunt et aër, et omnia cruda, et aqua, ut a calore dilatentur[22]) et per istam fugam et eruptionem interim flammam sulphuris, tanquam follibus occultis, undequaque exufflante.

Poterunt autem esse *instantiæ crucis* circa hoc subjectum duorum generum. Alterum eorum corporum, quæ maxime sunt inflammabilia, qualia sunt sulphur, caphura, naphtha, et hujusmodi, cum eorum misturis; quæ citius et facilius concipiunt flammam, quam pulvis pyrius, si non impediantur: ex quo liquet, appetitum inflammandi per se effectum illum stupendum non operari. Alterum eorum, quæ flammam fugiunt et ex-

[22] "hoc faciunt, ut dilatentur." I have kept the subjunctive in the Latin Text, and suppose that it must be translated simply, "air, &c. are expanded." It seems an extraordinary phrase, and one of no authority; *faciunt* being used as if it was *patiuntur*. In the translation published in another volume, I have ventured to take it as if Bacon had written "dilatantur," i. e. "air, &c. burst forth when expanded under the influence of Heat."

horrent, qualia sunt sales omnes. Videmus enim, si jaciantur in ignem, spiritum aqueum erumpere cum fragore, antequam flamma concipiatur; quod etiam leniter fit in foliis paulo contumacioribus, parte aquea erumpente, antequam oleosa concipiat flammam. Sed maxime cernitur hoc in argento vivo, quod non male dicitur aqua mineralis. Hoc enim, absque inflammatione, per eruptionem et expansionem simplicem, vires pulveris pyrii fere adæquat; quod etiam admixtum pulveri pyrio ejus vires multiplicare dicitur.

(8.) Similiter, sit natura inquisita, transitoria natura flammæ, et extinctio ejus momentanea[23]. Non enim videtur natura flammea hic apud nos figi et consistere, sed singulis quasi momentis generari, et statim extingui. Manifestum enim est in flammis, quæ hic continuantur et durant, istam durationem non esse ejusdem flammæ in individuo, sed fieri per successionem novæ flammæ seriatim generatæ, minime autem manere eamdem flammam numero; id quod facile perspicitur ex hoc, quod subtracto alimento sive fomite flammæ, flamma statim pereat. Bivium autem circa hanc naturam tale est. Momentanea ista natura aut fit remittente se causa, quæ eam primo genuit, ut in lumine, sonis, et motibus (quos vocant) violentis; aut quod flamma in natura sua possit hic apud nos manere, sed a contrariis naturis circumfusis vim patiatur et destruatur.

Itaque poterit esse circa hoc subjectum *instantia crucis* talis. Videmus flammas in incendiis majoribus, quam alte in sursum ascendant. Quanto enim basis

[23] The transitory nature of Flame. Cf. supra, II. 13. Inst. 27. — Bacon's conclusions that Air compresses Flame, and that to say that kindled Air is Flame is absurd, are unfortunate dogmatisms on an insufficient basis, as Air is the chief supporter of Flame.

flammæ est latior, tanto vertex sublimior: itaque videtur principium exstinctionis fieri circa latera, ubi ab aëre flamma comprimitur, et male habetur. At meditullia flammæ, quæ aër non contingit, sed alia flamma undique circundat, eadem numero manent; neque extinguuntur, donec paulatim angustentur ab aëre per latera circumfuso. Itaque omnis flamma pyramidalis est basi circa fomitem largior, vertice autem (inimicante aëre, nec suppeditante fomite) acutior. At fumus angustior circa basim ascendendo dilatatur, et fit tanquam pyramis inversa; quia scilicet aër fumum recipit, flammam (neque enim quispiam somniet, aërem esse flammam accensam, cum sint corpora plane heterogenea) comprimit.

Accuratior autem poterit esse *instantia crucis* ad hanc rem accommodata, si res forte manifestari possit per flammas bicolores. Capiatur igitur situla parva ex metallo, et in ea figatur parva candela cerea accensa; ponatur situla in patera, et circumfundatur spiritus vini in modica quantitate, quæ ad labra situlæ non attingat; tum accende spiritum vini. At spiritus ille vini exhibebit flammam magis scilicet cæruleam, lychnus candelæ autem magis flavam. Notetur itaque utrum flamma lychni (quam facile est per colorem a flamma spiritus vini distinguere; neque enim flammæ, ut liquores, statim commiscentur) maneat pyramidalis, an potius magis tendat ad formam globosam, cum nihil inveniatur quod eam destruat aut comprimat. At hoc posterius si fiat, manere flammam eandem numero, quamdiu intra aliam flammam concludatur, nec vim inimicam aëris experiatur, pro certo ponendum est.

Atque de *instantiis crucis* hæc dicta sint[24]. Lon-

[24] Cf. Playfair, Encycl. Brit. vol. i. Diss. iii. p. 466. "In all those branches of science where it (the crucial method) cannot easily be resort-

giores autem in iis tractandis ad hunc finem fuimus, ut homines paulatim discant et assuefiant de natura judicare per *instantias crucis*, et experimenta lucifera, et non per rationes probabiles.

XXXVII.

Inter *prærogativas instantiarum* ponemus loco decimo quinto *instantias divortii*[25]; quæ indicant separationes naturarum earum, quæ ut plurimum occurrunt. Differunt autem ab instantiis, quæ subjunguntur *instantiis comitatus*; quia illæ indicant separationes naturæ alicujus ab aliquo concreto, cum quo illa familiariter consuescit; hæ vero separationes naturæ alicujus ab altera natura. Differunt etiam ab *instantiis crucis*, quia nihil determinant, sed monent tantum de separabilitate unius naturæ ab altera. Usus autem earum est ad prodendas falsas formas, et dissipandas leves contemplationes ex rebus obviis orientes; adeo ut veluti plumbum et pondera intellectui addant[26].

Exempli gratia: sint naturæ inquisitæ quatuor naturæ illæ, quas *contubernales* vult esse Telesius[27], et tanquam ex eadem camera: viz. calidum, lucidum,

ed to (the circumstances of an experiment being out of our power, and incapable of being varied at pleasure), there is often a great want of conclusive evidence. This holds of Agriculture, Medicine, Political Economy, &c. In these men deceive themselves in consequence of this, and think they are reasoning from fact and experience, when, in reality, they are only reasoning from a mixture of truth and falsehood."

[25] These "Instances of Divorce" are cases in which nothing is determined (as in Crucial Instances), but in which the distinctions between Classes in Nature are discerned. They appear at first sight like the Instantiæ Comitatus, but are not; for these latter are only indicative of the absence of some Nature or quality in concretes; i. e. in individuals with which they are usually connected: so Idiots would be Instantiæ Comitatus as lacking Reason—a quality of Humanity: while these Instances of Divorce are simply such cases as shew distinction between classes which are near one another — as light and heat.

[26] This phrase is the same as that in I. 104.

[27] Cf. supra, I. 116.

tenue, mobile, sive promptum ad motum. At plurimæ inveniuntur *instantiæ divortii* inter ipsas. Aër enim tenuis est et habilis ad motum, non calidus aut lucidus: luna lucida, absque calore: aqua fervens, calida absque lumine: motus acus ferreæ super versorium, pernix et agilis, et tamen in corpore frigido, denso, opaco: et complura id genus.

Similiter, sint naturæ inquisitæ natura corporea et actio naturalis[28]. Videtur enim non inveniri actio naturalis, nisi subsistens in aliquo corpore. Attamen possit fortasse esse circa hanc rem *instantia* nonnulla *divortii*. Ea est actio magnetica, per quam ferrum fertur ad magnetem, gravia ad globum terræ. Addi etiam possint aliæ nonnullæ operationes ad distans. Actio siquidem hujusmodi et in tempore fit, per momenta, non in puncto temporis; et in loco, per gradus et spatia. Est itaque aliquod momentum temporis, et aliquod intervallum loci, in quibus ista virtus sive actio hæret in medio inter duo illa corpora, quæ motum cient. Reducitur itaque contemplatio ad hoc; utrum illa corpora, quæ sunt termini motus, disponant vel alterent corpora media, ut per successionem et tactum

[28] This is an example of no great value. Bacon's use of the Terms *Virtus* and *Actio* is very vague. The point on which he means to insist is that there must be an exertion of force which is neither in the Iron nor in the Magnet, but between both; and that this, being sensibly inappreciable, is incorporeal. This conclusion is an assumption, and perhaps not a correct one. In all probability the attractive force of gravity (which corresponds to it) is physical and corporeal; though we may not be able to explain exactly what it is or how exerted. We are, in fact, ignorant of the real link between cause and effect in physical operations. Yet this instance, with its illustrations, shews that Bacon had got upon the track of the difficult questions of the transmission of Magnetism, Heat, Light, &c. from body to body, whose phenomena are yet but imperfectly, perhaps not at all, understood. His problem here is—must all operations in Nature be carried on by action in corporeal bodies; or are not some things (like Light) transmitted through an incorporeal medium?

verum labatur virtus a termino ad terminum, et interim subsistat in corpore medio; an horum nihil sit, præter corpora, et virtutem, et spatia? Atque in radiis opticis, et sonis, et calore, et aliis nonnullis operantibus ad distans, probabile est, media corpora disponi et alterari: eo magis, quod requiratur medium qualificatum ad deferendam operationem talem. At magnetica illa sive coitiva virtus admittit media tanquam adiaphora, nec impeditur virtus in omnigeno medio. Quod si nil rei habeat virtus illa aut actio cum corpore medio, sequitur quod sit virtus aut actio naturalis ad tempus nonnullum, et in loco nonnullo, subsistens sine corpore: cum neque subsistat in corporibus terminantibus, nec in mediis. Quare actio magnetica poterit esse *instantia divortii*, circa naturam corpoream, et actionem naturalem. Cui hoc adjici potest tanquam corollarium aut lucrum non prætermittendum: viz. quod etiam secundum sensum philosophanti sumi possit probatio[29], quod sint entia, et substantiæ separatæ et incorporeæ. Si enim virtus et actio naturalis, emanans a corpore, subsistere possit aliquo tempore, et aliquo loco, omnino sine corpore; prope est ut possit etiam emanare in origine sua a substantia incorporea. Videtur enim non minus requiri natura corporea ad actionem naturalem sustentandam et devehendam, quam ad excitandam aut generandam.

XXXVIII.

Sequuntur quinque ordines *instantiarum*, quas uno vocabulo generali *instantias lampadis*[30], sive *informationis primæ*, appellare consuevimus. Eæ sunt, quæ

[29] This, too,—an attempt to prove the existence of an incorporeal Nature by the senses—is strange.

[30] Instances of the Lamp, because they propose chiefly to enlighten our dark senses, and to make our apprehension of facts more correct.

auxiliantur sensui. Cum enim omnis *interpretatio naturæ* incipiat a sensu; atque a sensuum perceptionibus, recta, constanti, et munita via, ducat ad perceptiones intellectus, quæ sunt notiones veræ et axiomata: necesse est, ut quanto magis copiosæ et exactæ fuerint repræsentationes, sive præbitiones ipsius sensus, tanto omnia cedant facilius et felicius.

Harum autem quinque *instantiarum lampadis*, primæ[31] roborant, ampliant, et rectificant actiones sensus immediatas: secundæ deducunt non-sensibile ad sensibile: tertiæ indicant processus continuatos sive series earum rerum et motuum, quæ (ut plurimum) non notantur, nisi in exitu aut periodis: quartæ aliquid substituunt sensui in meris destitutionibus: quintæ excitant attentionem sensus et advertentiam, atque una limitant subtilitatem rerum. De his autem singulis jam dicendum est.

XXXIX.

Inter *prærogativas instantiarum*, ponemus loco decimo sexto *instantias januæ* sive *portæ*: eo enim nomine eas appellamus, quæ juvant actiones sensus immediatas. Inter sensus autem manifestum est partes primas tenere visum, quoad informationem: quare huic sensui præcipue auxilia conquirenda. Auxilia autem triplicia esse posse videntur: vel ut percipiat non

[31] The 1st (Januæ) provide Instrumental aid, like the Telescope, &c., to increase and improve the impressions of sense.

The 2nd (Citantes) enlarge our sphere of sensible appreciation. Such would be the Air-pump, the Barometer, or the Electrical Machine.

The 3rd (Viæ) shew the gradual process of Nature—that it is not "per saltum."

The 4th (Supplementi) supply information where the senses fail. He instances Magnetism.

The 5th (Persecantes) penetrate into the subtle nature of things, and excite the attention of the senses to subtle facts, which before they were wont to neglect.

visa; vel ut majore intervallo; vel ut exactius et distinctius.

Primi generis sunt (missis bis-oculis[32], et hujusmodi, quæ valent tantum ad corrigendam et levandam infirmitatem visus non bene dispositi, atque ideo nihil amplius informant) ea, quæ nuper inventa sunt perspicilla; quæ latentes et invisibiles corporum minutias, et occultos schematismos, et motus (aucta insigniter specierum magnitudine) demonstrant; quorum vi, in pulice, musca, vermiculis, accurata corporis figura et lineamenta, nec non colores et motus prius non conspicui, non sine admiratione cernuntur. Quinetiam aiunt, lineam rectam calamo vel penicillo descriptam, per hujusmodi perspicilla inæqualem admodum et tortuosam cerni: quia scilicet nec motus manus licet per regulam adjutæ, nec impressio atramenti aut coloris, revera æqualia existant; licet illæ inæqualitates tam minutæ sint, ut sine adjumento hujusmodi perspicillorum conspici nequeant. Etiam superstitiosam quandam observationem in hac re (ut fit in rebus novis et miris) addiderunt homines: viz. quod hujusmodi perspicilla opera naturæ illustrent, artis dehonestent. Illud vero nihil aliud est, quam quod texturæ naturales multo subtiliores sint quam artificiosæ. Perspicillum enim illud ad minuta tantum valet: quale perspicillum si vidisset Democritus[33], exsiluisset forte, et modum videndi atomum (quam ille invisibilem omnino affirmavit) inventum fuisse putasset. Verum incompetentia hujusmodi perspicillorum, præterquam ad minutias tantum, (neque ad ipsas quoque, si fuerint in corpore ma-

[32] Bis-oculi, Spectacles. There is also an account of the "Perspicillum," or Magnifying-glass, which Bacon himself (from his language "Quinetiam aiunt") seems not to have known much about, or to have used himself. It was of course the germ of the Microscope.

[33] Cf. supr. I. 51, &c.

jusculo) usum rei destruit. Si enim inventum extendi posset ad corpora majora, aut corporum majorum minutias; adeo ut textura panni lintei conspici posset tanquam rete; atque hoc modo minutiæ latentes et inæqualitates gemmarum, liquorum, urinarum, sanguinis, vulnerum, et multarum aliarum rerum cerni possent; magnæ proculdubio ex eo invento commoditates capi possent.

Secundi generis sunt illa altera perspicilla, quæ memorabili conatu adinvenit Galilæus[34]: quorum ope, tanquam per scaphas aut naviculas, aperiri et exerceri possint propiora cum cœlestibus commercia. Hinc enim constat, galaxiam esse nodum sive coacervationem stellarum parvarum, plane numeratarum et distinctarum: de qua re apud antiquos tantum suspicio fuit. Hinc demonstrari videtur, quod spatia orbium (quos vocant) planetarum non sint plane vacua aliis stellis; sed quod cœlum incipiat stellascere, antequam ad cœlum ipsum stellatum ventum sit; licet stellis minoribus, quam ut sine perspicillis istis conspici possint. Hinc choreas illas stellarum parvarum circa planetam Jovis (unde conjici possit, esse in motibus stellarum plura centra[35])

[34] Remarkable as a mention of Galileo with approbation. Some have denied that Galileo really invented the Telescope. But it seems to have been his discovery. See Drinkwater's Life of Galileo, published in the Library of Useful Knowledge, chap. vi. The single lens and its use were well known long before Galileo, and there are passages in both Fracastoro's writings and in those of Baptista Porta, which seem to shew that they had tried to combine two lenses together. Roger Bacon's language has led some to conceive (see Palgrave's Merchant and Friar) that he was really the inventor of the Telescope: but this does not seem to have been the case. At any rate Galileo was the first person who invented it from scientific principles. He combined a plano-convex and a plano-concave lens, the latter the nearer to the eye, distant from each other by the difference of their focal lengths;—their principle was that of the Opera-glass. He also constructed Microscopes on the same principle.

[35] This reference to the Satellites of Jupiter; and the possibility of many centres, shews that Bacon was after all prepared to accept the

intueri licet. Hinc inæqualitates luminosi et opaci in luna distinctius cernuntur et locantur; adeo ut fieri possit quædam seleno-graphia. Hinc maculæ in sole; et id genus: omnia certe inventa nobilia, quatenus fides hujusmodi demonstrationibus tuto adhiberi possit. Quæ nobis ob hoc maxime suspectæ sunt, quod in istis paucis sistatur experimentum, neque alia complura investigatu æque digna eadem ratione inventa sint.

Tertii generis sunt bacilla illa ad terras mensurandas, astrolabia, et similia: quæ sensum videndi non ampliant, sed rectificant et dirigunt. Quod si sint aliæ instantiæ, quæ reliquos sensus juvent in ipsorum actionibus immediatis et individuis; tamen si ejusmodi sint, quæ informationi ipsi nihil addant plus quam jam habetur, ad id, quod nunc agitur, non faciunt. Itaque earum mentionem non fecimus.

XL.

Inter *prærogativas instantiarum* ponemus loco decimo septimo *instantias citantes;* sumpto vocabulo a foris civilibus, quia citant ea ut compareant, quæ prius non comparuerunt: quas etiam *instantias evocantes* appellare consuevimus. Eæ deducunt non-sensibile ad sensibile[36].

Sensum autem fugiunt res, vel (1) propter distantiam objecti locati[37]; vel (2) propter interceptionem

truth had it been revealed in his own day. The Selenography which he foresees, has, of course, been carried to great perfection; and the spots in the Sun were first discovered by Harriot in 1610; and from them it was calculated that the Sun revolves on its own axis in about 25 days 7 hours. Bacon's caution is not to be despised, though his haste in affirming that "in istis paucis sistatur experimentum" is to be blamed. Galileo discovered the Satellites of Jupiter.

[36] It is hard to translate this "deducunt" without some such periphrasis as "bring down to the range of the Senses that which was previously beyond them."

[37] This class runs into that of the "Janua." For surely stars not visible to the naked eye, but disco-

sensus per corpora media; vel (3) quia objectum non est habile ad impressionem in sensu faciendam; vel (4) quia deficit quantum in objecto pro feriendo sensu; vel (5) quia tempus non est proportionatum ad actuandum sensum; vel (6) quia objecti percussio non toleratur a sensu; vel (7) quia objectum ante implevit et possedit sensum, ut novo motui non sit locus. Atque hæc præcipue ad visum pertinent, et deinde ad tactum. Nam hi duo sensus sunt informativi ad largum, atque de communibus objectis; ubi reliqui tres non informent fere, nisi immediate, et de propriis objectis.

(1) In primo genere non fit deductio ad sensibile, nisi rei, quæ cerni non possit propter distantiam, adjiciatur aut substituatur alia res, quæ sensum magis e longinquo provocare et ferire possit: veluti in significatione rerum per ignes, campanas, et similia.

(2) In secundo genere fit deductio, cum ea, quæ interius propter interpositionem corporum latent, nec commode aperiri possunt, per ea, quæ sunt in superficie, aut ab interioribus effluunt, perducuntur ad sensum: ut status humanorum corporum per pulsus, et urinas, et similia.

(3, 4) At tertii et quarti generis deductiones ad plurima spectant, atque undique in rerum inquisitione sunt conquirendæ. Hujus rei exempla sunt. Patet quod aër, et spiritus, et hujusmodi res, quæ sunt toto corpore tenues et subtiles, nec cerni nec tangi possint.

verable with a Telescope, would be apt illustrations of this subdivision. The second division may be well illustrated by the Stethescope. The third by the chemical detection of Gases, or (e. g.) the discovery of Actinism in rays of the Sun by exposure of a plate of silver to them. The fourth would be brought before us by the Microscope. Of the fifth, the measurement of very rapid intervals by electric light would be an instance. Of the sixth, coloured glasses to shade off the Sun's light. Of the seventh, he adduces strong smells as his example, but thinks the class one of no great importance.

Quare in inquisitione circa hujusmodi corpora, deductionibus omnino est opus.

Sit itaque natura inquisita, actio et motus spiritus[38], qui includitur in corporibus tangibilibus. Omne enim tangibile apud nos continet spiritum invisibilem et intactilem, eique obducitur, atque eum quasi vestit. Hinc fons triplex potens ille, et mirabilis *processus* spiritus in corpore tangibili. Spiritus enim in re tangibili, emissus, corpora contrahit et desiccat; detentus, corpora intenerat et colliquat: nec prorsus emissus, nec prorsus detentus, informat, membrificat, assimilat, egerit, organizat, et similia. Atque hæc omnia deducuntur ad sensibile per effectus conspicuos.

Etenim in omni corpore tangibili inanimato, spiritus inclusus primo multiplicat se, et tanquam depascit partes tangibiles eas, quæ sunt maxime ad hoc faciles et præparatæ; easque digerit, et conficit, et vertit in spiritum, et deinde una evolant. Atque hæc confectio et multiplicatio spiritus deducitur ad sensum per diminutionem ponderis. In omni enim desiccatione aliquid defluit de quanto; neque id ipsum ex spiritu tantum præinexistente, sed ex corpore quod prius fuit tangibile, et noviter versum est: spiritum enim non ponde-

[38] See I. 50 (note 64). This search after the nature of "Spirits" was in reality a search for the principle of Life in "Animate" objects—but it was also more: for Bacon speaks often of the "Spirit" in Iron. It is however very far from modern Pantheism; and is more like a crude and obscure conception of Electricity, and gaseous agencies, than ought else. To illustrate Bacon's language, I may venture again to quote Milton's Paradise Lost, v. 484.

"Flowers and their fruit
Man's nourishment, by gradual scale sublimed,
To vital Spirits aspire, to Animal,
To intellectual give both life and sense,
Fancy and understanding; whence the Soul
Reason receives, and Reason in her Being
Discursive or Intuitive."

rat. Egressus autem sive emissio spiritus deducitur ad sensibile in rubigine metallorum, et aliis putrefactionibus[39] ejus generis, quæ sistunt se antequam pervenerint ad rudimenta vitæ; nam illæ ad tertium genus *processus* pertinent. Etenim in corporibus magis compactis spiritus non invenit poros et meatus, per quos evolet: itaque cogitur partes ipsas tangibiles protrudere et ante se agere, ita ut illæ simul exeant; atque inde fit rubigo, et similia. At contractio partium tangibilium, postquam aliquid de spiritu fuerit emissum, (unde sequitur illa desiccatio) deducitur ad sensibile, tum per ipsam duritiem rei auctam, tum multo magis per scissuras, angustationes, corrugationes, et complicationes corporum, quæ inde sequuntur. Etenim partes ligni desiliunt et angustantur; pelles corrugantur: neque id solum, sed (si subita fuerit emissio spiritus per calorem ignis) tantum properant ad contractionem, ut se complicent et convolvant.

At contra, ubi spiritus detinetur, et tamen dilatatur et excitatur per calorem aut ejus analoga; (id quod fit in corporibus magis solidis aut tenacibus) tum vero corpora emolliuntur, ut ferrum candens; fluunt, ut metalla; liquescunt, ut gummi, cera, et similia. Itaque contrariæ illæ operationes caloris (ut ex eo alia durescant, alia liquescant[40]) facile reconciliantur; quia in illis, spiritus emittitur; in his, agitatur et detinetur: quorum posterius est actio propria caloris et spiritus; prius actio partium tangibilium tantum per occasionem spiritus emissi.

Ast ubi spiritus nec detinetur prorsus, nec prorsus

[39] Rust arises from the Chemical Affinity which attracts the Oxygen in the Air to the Iron.

[40] "Limus ut hic durescit, et hæc ut cera liquescit
Uno eodemque igni." Virg. Ecl. viii. 80.

emittitur; sed tantum inter claustra sua tentat et experitur, atque nacta est partes tangibiles obedientes et sequaces in promptu; ita ut quo spiritus agit, eæ simul sequantur: tum vero sequitur efformatio in corpus organicum, et membrificatio, et reliquæ actiones vitales, tam in vegetabilibus quam in animalibus. Atque hæc maxime deducuntur ad sensum, per notationes diligentes primorum inceptuum et rudimentorum sive tentamentorum vitæ in animalculis ex putrefactione natis, ut in ovis formicarum, vermibus, muscis, ranis post imbrem, &c. Requiritur autem ad vivificationem, et lenitas caloris, et lentor corporis; ut spiritus nec per festinationem erumpat, nec per contumaciam partium coërceatur: quin potius ad ceræ modum illas plicare et effingere possit.

Rursus, differentia illa spiritus maxime nobilis, et ad plurima pertinens, (viz. spiritus abscissi; ramosi simpliciter; ramosi simul et cellulati: ex quibus prior, est spiritus omnium corporum inanimatorum; secundus, vegetabilium; tertius, animalium:) per plurimas instantias deductorias tanquam sub oculos ponitur.

Similiter patet, quod subtiliores texturæ et schematismi rerum (licet toto corpore visibilium, aut tangibilium) nec cernantur, nec tangantur. Quare in his quoque per deductionem procedit informatio. At differentia schematismorum maxime radicalis et primaria sumitur ex copia vel paucitate materiæ, quæ subit idem spatium sive dimensum. Reliqui enim schematismi (qui referuntur ad dissimilaritates partium, quæ in eodem corpore continentur, et collocationes ac posituras earundem) præ illo altero sunt secundarii.

Sit itaque natura inquisita, expansio sive coitio materiæ in corporibus respective: viz. quantum materiæ impleat quantum dimensum in singulis. Etenim nil

verius in natura, quam propositio illa gemella; *Ex nihilo nihil fieri:* neque, *Quicquam in nihilum redigi*[41]: verum quantum ipsum materiæ sive summam totalem constare, nec augeri aut minui. Nec illud minus verum; *Ex quanto illo materiæ sub iisdem spatiis sive dimensionibus, pro diversitate corporum, plus et minus contineri;* ut in aqua plus, in aëre minus: adeo ut si quis asserat, aliquod contentum aquæ in par contentum aëris verti posse, idem sit ac si dicat, aliquid posse redigi in nihilum: contra si quis asserat, aliquod contentum aëris in par contentum aquæ verti posse; idem sit ac si dicat, aliquid posse fieri ex nihilo. Atque ex copia ista et paucitate materiæ, notiones illæ *densi* et *rari*, quæ varie et promiscue accipiuntur, proprie abstrahuntur. Assumenda est et assertio illa tertia, etiam satis certa; quod hoc, de quo loquimur, plus et minus materiæ in corpore hoc vel illo, ad calculos (facta collatione) et proportiones exactas, aut exactis propinquas, reduci possit[42]. Veluti si quis dicat, inesse in dato contento auri talem coacervationem materiæ, ut opus

[41] See Persius, Sat. ii. 83, 84.

> ——— gigni
> De nihilo, in nihilum nil posse reverti.

And Lucretius, Bk. i.

> "Nil igitur fieri de nilo posse putandum est."

The dogma is also to be found in Aristotle's Phys. Ausc. IV. chap. i. *πᾶν τὸ γινόμενον ἀνάγκη γίνεσθαι ἢ ἐξ ὄντων ἢ ἐκ μὴ ὄντων. τούτων δὲ τὸ μὲν ἐκ μὴ ὄντων γίνεσθαι ἀδύνατον· περὶ γὰρ ταύτης ὁμογνωμονοῦσι τῆς δόξης ἅπαντες οἱ περὶ φύσεως.*

[42] He wishes here to express the fact, that one must have a standard of measurement of weight; and by weight of density. This he takes to be Spirits of Wine; we use Water. His ratio 21 : 1 is absurd, as is his rejection of "porous and spongy" matters. He seems too to consider that his "Spirits" are material, and ponderable possibly. This looks almost as if he meant by these Spiritus the gases in nature. And his experiment given below is a good illustration of the want of appliances and instruments under which he laboured, and which he sought to lessen. The Airpump has filled up the void in this particular case.

habeat spiritus vini, ad tale quantum materiæ æquandum, spatio vicies et semel majore quam implet aurum, non erraverit.

Coacervatio autem materiæ, et rationes ejus deducuntur ad sensibile per pondus. Pondus enim respondet copiæ materiæ, quoad partes rei tangibilis: spiritus autem, et ejus quantum ex materia, non venit in computationem per pondus; levat enim pondus potius quam gravat. At nos hujus rei tabulam fecimus satis accuratam; in qua pondera et spatia singulorum metallorum, lapidum præcipuorum, lignorum, liquorum, oleorum, et plurimorum aliorum corporum, tam naturalium quam artificialium, excepimus: rem polychrestam, tam ad lucem informationis, quam ad normam operationis; et quæ multas res revelet omnino præter expectatum. Neque illud pro minimo habendum est, quod demonstret, omnem varietatem, quæ in corporibus tangibilibus nobis notis versatur, (intelligimus autem corpora bene unita, nec plane spongiosa, et cava, et magna ex parte aëre impleta) non ultra rationes partium viginti et unius excedere: tam finita scilicet est natura, aut saltem illa pars ejus, cujus usus ad nos maxime pertinet.

Etiam diligentiæ nostræ esse putavimus, experiri, si forte capi possint rationes corporum non tangibilium sive pneumaticorum, respectu corporum tangibilium. Id quod tali molitione aggressi sumus. Phialam vitream accepimus, quæ unciam fortasse unam capere possit: parvitate vasis usi, ut minori cum calore posset fieri evaporatio sequens. Hanc phialam spiritu vini implevimus fere ad collum; eligentes spiritum vini, quod per tabulam priorem, eum esse ex corporibus tangibilibus (quæ bene unita, nec cava sunt) rarissimum, et minimum continens materiæ sub suo dimenso, observavi-

mus. Deinde pondus spiritus cum phiala ipsa exacte notavimus. Postea vesicam accepimus, quæ circa duas pintas contineret. Ex ea aërem omnem, quoad fieri potuit, expressimus, eo usque ut vesicæ ambo latera essent contigua: etiam prius vesicam oleo oblevimus cum fricatione leni, quo vesica esset clausior; ejus, siqua erat, porositate oleo obturata. Hanc vesicam circa os phialæ, ore phialæ intra os vesicæ recepto, fortiter ligavimus; filo parum cerato, ut melius adhæresceret et arctius ligaret. Tum demum phialam supra carbones ardentes in foculo collocavimus. At paulo post vapor sive aura spiritus vini per calorem dilatati, et in pneumaticum versi, vesicam paulatim sufflavit, eamque universam veli instar undequaque extendit. Id postquam factum fuit, continuo vitrum ab igne removimus, et super tapetem posuimus, ne frigore disrumperetur: statim quoque in summitate vesicæ foramen fecimus, ne vapor, cessante calore, in liquorem restitutus resideret, et rationes confunderet. Tum vero vesicam ipsam sustulimus, et rursus pondus excepimus spiritus vini qui remanebat. Inde quantum consumptum fuisset in vaporem seu pneumaticum, computavimus; et facta collatione, quantum locum sive spatium illud corpus implesset, quando esset spiritus vini in phiala, et rursus quantum spatium impleverit, postquam factum fuisset pneumaticum in vesica, rationes subduximus: ex quibus manifeste liquebat, corpus istud ita versum et mutatum expansionem centuplo majorem, quam antea habuisset, acquisivisse.

Similiter sit natura inquisita, calor aut frigus; ejus nempe gradus, ut a sensu non percipiantur ob debilitatem. Hæc deducuntur ad sensum per vitrum calendare, quale superius descripsimus. Calor enim et frigus, ipsa non percipiuntur ad tactum: at calor aërem ex-

pandit, frigus contrahit. Neque rursus illa expansio et contractio aëris percipitur ad visum: at aër ille expansus aquam deprimit, contractus attollit; ac tum demum fit deductio ad visum, non ante, aut alias.

Similiter sit natura inquisita, mistura corporum; viz. quid habeant ex aqueo, quid ex oleoso, quid ex spiritu, quid ex cinere, et salibus, et hujusmodi: vel etiam (in particulari) quid habeat lac butyri, quid coaguli, quid seri, et hujusmodi. Hæc deducuntur ad sensum per artificiosas et peritas separationes, quatenus ad tangibilia. At natura spiritus in ipsis, licet immediate non percipiatur, tamen deprehenditur per varios motus et nixus corporum tangibilium, in ipso actu et processu separationis suæ: atque etiam per acrimonias, corrosiones, et diversos colores, odores, et sapores eorundem corporum post separationem. Atque in hac parte, per distillationes atque artificiosas separationes, strenue sane ab hominibus elaboratum est; sed non multo felicius quam in cæteris experimentis, quæ adhuc in usu sunt: modis nimirum prorsus palpatoriis, et viis cæcis, et magis operose quam intelligenter; et (quod pessimum est) nulla cum imitatione aut æmulatione naturæ, sed cum destructione (per calores vehementes, aut virtutes nimis validas) omnis subtilioris schematismi, in quo occultæ rerum virtutes et consensus præcipue sitæ sunt. Neque illud etiam, quod alias monuimus[42], hominibus in mentem aut observationem venire solet in hujusmodi separationibus: hoc est, plurimas qualitates in corporum vexationibus, tam per ignem quam alios modos, indi ab ipso igne iisque corporibus, quæ ad separationem adhibentur, quæ in composito prius non fuerunt; unde miræ fallaciæ. Neque enim scilicet

[42] Cf. supr. II. 7.

vapor universus, qui ex aqua emittitur per ignem, vapor aut aër antea fuit in corpore aquæ; sed factus est maxima ex parte per dilatationem aquæ ex calore ignis.

Similiter in genere omnes exquisitæ probationes corporum, sive naturalium sive artificialium, per quas vera dignoscuntur ab adulterinis, meliora a vilioribus, huc referri debent: deducunt enim non-sensibile ad sensibile. Sunt itaque diligenti cura undique conquirendæ.

(5.) Quintum vero genus latitantiæ quod attinet; manifestum est, actionem sensus transigi in motu, motum in tempore. Si igitur motus alicujus corporis sit vel tam tardus, vel tam velox, ut non sit proportionatus ad momenta, in quibus transigitur actio sensus, objectum omnino non percipitur: ut in motu indicis horologii, et rursus in motu pilæ sclopeti. Atque motus, qui ob tarditatem non percipitur, facile et ordinario deducitur ad sensum per summas motus; qui vero ob velocitatem, adhuc non bene mensurari consuevit[43]; sed tamen postulat inquisitio naturæ, ut hoc fiat in aliquibus.

(6.) Sextum autem genus, ubi impeditur sensus propter nobilitatem objecti, recipit deductionem; vel per elongationem majorem objecti a sensu; vel per hebetationem objecti per interpositionem medii talis, quod objectum debilitet, non annihilet; vel per admissionem et exceptionem objecti reflexi, ubi percussio directa sit nimis fortis; ut solis in pelvi aquæ.

(7.) Septimum autem genus latitantiæ, ubi sensus ita oneratur objecto, ut novæ admissioni non sit locus, non

[43] Cf. Herschel's Discourse on Natural Philosophy, § 18. Motion of great velocity is now readily measured by means of Electricity.

habet fere locum nisi in olfactu et odoribus; nec ad id quod agitur multum pertinet. Quare de deductionibus non-sensibilis ad sensibile hæc dicta sint.

Quandoque tamen deductio fit non ad sensum hominis, sed ad sensum alicujus alterius animalis, cujus sensus in aliquibus humanum excellit: ut nonnullorum odorum, ad sensum canis; lucis, quæ in aëre non extrinsecus illuminato latenter existit, ad sensum felis, noctuæ, et hujusmodi animalium, quæ cernunt noctu. Recte enim notavit Telesius[44], etiam in aëre ipso inesse lucem quandam originalem, licet exilem et tenuem, et maxima ex parte oculis hominum aut plurimorum animalium non inservientem: quia illa animalia, ad quorum sensum hujusmodi lux est proportionata, cernant noctu; id quod vel sine luce fieri, vel per lucem internam, minus credibile est.

Atque illud utique notandum est; de destitutionibus sensum, eorumque remediis, hic nos tractare. Nam fallaciæ sensuum ad proprias inquisitiones de sensu et sensibili remittendæ sunt: excepta illa magna fallacia sensuum, nimirum quod constituant lineas rerum ex analogia hominis, et non ex analogia universi: quæ non corrigitur, nisi per rationem et philosophiam universalem[45].

XLI.

Inter *prærogativas instantiarum* ponemus loco de-

[44] This notion of Telesio (of which Bacon approved) is now entirely exploded. Air is not self-luminous. And Cats, &c. which are said to see in the dark, are only able to see with far less light than man, from the peculiar formation of their eyes, which catch more readily than man's do the few rays which float in the air even in the night. For Telesio, see supra, I. 116. II. 37.

[45] This remark is true of other subjects as well as of sensible appreciation. We are obliged, by the constitution of our Nature, to measure things by ourselves. Even the Bible often expresses truths of the highest kind by means of terms relative to us, and adapted to our limited intelligence. And this will continue while man does but "know in part."

cimo octavo *instantias viæ;* quas etiam *instantias itinerantes, et instantias articulatas* appellare consuevimus[46]. Eæ sunt, quæ indicant naturæ motus gradatim continuatos. Hoc autem genus instantiarum potius fugit observationem, quam sensum. Mira enim est hominum circa hanc rem indiligentia. Contemplantur siquidem naturam tantummodo desultorie et per periodos, et postquam corpora fuerint absoluta ac completa, et non in operatione sua. Quod si artificis alicujus ingenia et industriam explorare et contemplari quis cuperet, is non tantum materias rudes artis, atque deinde opera perfecta, conspicere desideraret; sed potius præsens esse, cum artifex operatur et opus suum promovet. Atque simile quiddam circa naturam faciendum est. Exempli gratia; si quis de vegetatione plantarum inquirat, ei inspiciendum est ab ipsa satione seminis alicujus, (id quod per extractionem, quasi singulis diebus, seminum, quæ per biduum, triduum, quatriduum, et sic deinceps in terra manserunt, eorumque diligentem intuitum, facile fieri potest) quomodo et quando semen intumescere et turgere incipiat, et veluti spiritu impleri; deinde quomodo corticulam rumpere, et emittere fibras, cum latione nonnulla sui interim sursum, nisi terra fuerit admodum contumax; quomodo etiam emittat fibras, partim radicales deorsum, partim cauliculares sursum, aliquando serpendo per latera, si ex ea parte inveniat terram apertam et magis facilem, et complura id genus. Similiter facere oportet circa exclusionem ovorum; ubi facile conspici dabitur processus vivificandi et organizandi, et quid et quæ partes

[46] What has been said of *Migrating Instances* is also true here. Cf. supra, II. 23. It is hard to distinguish between them, except that these *Instances of the Way* are only instrumental to advise and help the senses. Both of them touch upon the province of the *Latent Process;* as Bacon allows at the end of this Aphorism.

fiant ex vitello, quid ex albumine ovi, et alia. Similis est ratio circa animalia ex putrefactione. Nam circa animalia perfecta et terrestria, per exsectiones fœtuum ex utero, minus humanum esset ista inquirere[47]; nisi forte per occasiones abortuum, et venationum, et similium. Omnino igitur vigilia quædam servanda est circa naturam, ut quæ melius se conspiciendam præbeat noctu, quam interdiu. Istæ enim contemplationes tanquam nocturnæ censeri possint, ob lucernæ parvitatem et perpetuationem.

Quin et in inanimatis idem tentandum est: id quod nos fecimus in inquirendis aperturis liquorum per ignem. Alius enim est modus aperturæ in aqua, alius in vino, alius in aceto, alius in omphacio; longe alius in lacte, et oleo, et cæteris. Id quod facile cernere erat per ebullitionem super ignem lenem, et in vase vitreo, ubi omnia cerni perspicue possint. Verum hæc brevius perstringimus; fusius et exactius de iis sermones habituri, cum ad inventionem *latentis* rerum *processus* ventum erit. Semper enim memoria tenendum est, nos hoc loco non res ipsas tractare, sed exempla tantum adducere.

XLII.

Inter *prærogativas instantiarum*, ponemus loco decimo nono *instantias supplementi*, sive *substitutionis;* quas etiam *instantias perfugii* appellare consuevimus[48].

[47] Bacon's humanity is here conspicuous by the side of some of the modern Physical discoverers; whose experiments on Instinct — on the sensitive and other nerves — have been marked by a disregard of animal suffering.

[48] This substitution is to be twofold—(1) per graduationem—which, one would have thought, might be brought about by the *Tabulæ graduum* without this; and (2) per analoga. Such would be Bp. Butler's substitution of the laws of Physics in the investigation of the Moral and Religious Laws of God. In all subjects false Analogies—apparent and not real parallels—have been a continual source of error: and nothing is so alluring or dan-

Eæ sunt, quæ supplent informationem, ubi sensus plane destituitur: atque idcirco ad eas confugimus, cum instantiæ propriæ haberi non possint. Dupliciter autem fit substitutio: aut per graduationem, aut per analoga. Exempli gratia: non invenitur medium, quod inhibeat prorsus operationem magnetis in movendo ferrum: non aurum interpositum, non argentum, non lapis, non vitrum, lignum, aqua, oleum, pannus aut corpora fibrosa, aër, flamma, et cætera. Attamen per probationem exactam fortasse inveniri possit aliquod medium, quod hebetet virtutem ipsius plus quam aliquod aliud, comparative et in aliquo gradu: veluti quod non trahat magnes ferrum per tantam crassitiem auri, quam per par spatium aëris; aut per tantum argentum ignitum, quam per frigidum; et sic de similibus. Nam de his nos experimentum non fecimus: sed sufficit tamen, ut proponantur loco exempli. Similiter non invenitur hic apud nos corpus, quod non suscipiat calidum igni approximatum. Attamen longe citius suscipit calorem aër, quam lapis. Atque talis est substitutio, quæ fit per gradus.

Substitutio autem per analoga, utilis sane, sed minus certa est; atque idcirco cum judicio quodam adhibenda. Ea fit, cum deducitur non-sensibile ad sensum; non per operationes sensibiles ipsius corporis insensibilis, sed per contemplationem corporis alicujus cognati sensibilis. Exempli gratia: si inquiratur de mistura spirituum, qui sunt corpora non-visibilia: vi-

gerous. They must be kept within strict limits of *Homogeneity*, or else they will mislead. Beyond those limits Analogy will indeed give *hints* and chance probabilities; but within those limits the argument is strong, and almost conclusive. So in Harvey's great discovery; as the valves in plants are to the sap, &c. so are the valves in the veins to Blood. The cases are Homogeneous: it is the principle of the growth of living beings, which, in both cases, would be under the same law.

detur esse cognatio quædam inter corpora et fomites sive alimenta sua. Fomes autem flammæ videtur esse oleum et pinguia; aëris, aqua et aquea: flammæ enim multiplicant se super halitus olei, aër super vapores aquæ. Videndum itaque de mistura aquæ et olei, quæ se manifestat ad sensum; quandoquidem mistura aëris et flammei generis fugiat sensum. At oleum et aqua inter se per compositionem aut agitationem imperfecte admodum miscentur, eadem in herbis, et sanguine, et partibus animalium, accurate et delicate miscentur. Itaque simile quiddam fieri possit circa misturam flammei et aërei generis in spiritalibus: quæ per confusionem simplicem non bene sustinent misturam: eadem tamen in spiritibus plantarum et animalium misceri videntur: præsertim cum omnis spiritus animatus depascat humida utraque, aquea et pinguia, tanquam fomites suos.

Similiter, si non de perfectioribus misturis spiritalium, sed de compositione tantum inquiratur; nempe, utrum facile inter se incorporentur; an potius (exempli gratia) sint aliqui venti et exhalationes, aut alia corpora spiritalia, quæ non miscentur cum aëre communi, sed tantum hærent et natant in eo, in globulis et guttis, et potius franguntur ac comminuuntur ab aëre, quam in ipsum recipiuntur et incorporantur: hoc in aëre communi et aliis spiritalibus, ob subtilitatem corporum, percipi ad sensum non potest; attamen imago quædam hujus rei, quatenus fiat, concipi possit in liquoribus argenti vivi, olei, aquæ; atque etiam in aëre, et fractione ejus, quando dissipatur et ascendit parvis portiunculis per aquam; atque etiam in fumis crassioribus, denique in pulvere excitato et hærente in aëre; in quibus omnibus non fit incorporatio. Atque repræsentatio prædicta in hoc subjecto non mala est, si illud

primo diligenter inquisitum fuerit, utrum possit esse talis heterogenea inter spiritalia, qualis invenitur inter liquida: nam tum demum hæc simulacra per analogiam non incommode substituentur.

Atque de *instantiis* istis *supplementi*, quod diximus, informationem ab iis hauriendam esse, quando desint instantiæ propriæ, loco *perfugii;* nihilominus intelligi volumus, quod illæ etiam magni sint usus, etiam cum propriæ instantiæ adsint; ad roborandam scilicet informationem una cum propriis. Verum de his exactius dicemus, quando ad *adminicula inductionis* tractanda sermo ordine dilabetur [49].

XLIII.

Inter *prærogativas instantiarum*, ponemus loco vicesimo *instantias persecantes;* quas etiam *instantias vellicantes* appellare consuevimus, sed diversa ratione. *Vellicantes* enim eas appellamus, quia vellicant intellectum [50], *persecantes*, quia persecant naturam: unde etiam illas quandoque *instantias Democriti* [51] nominamus. Eæ sunt, quæ de admirabili et exquisita subtilitate naturæ intellectum submonent, ut excitetur et expergiscatur ad attentionem, et observationem, et inquisitionem debitam. Exempli gratia: quod parum guttulæ atramenti ad tot literas vel lineas extendatur; quod argentum, exterius tantum inauratum, ad tantam longitudinem fili inaurati continuetur; quod pusillus vermiculus, qualis in cute invenitur, habeat in se spiritum simul et figuram dissimilarem partium [52]; quod

[49] Cf. supra, II. 21. These *adminicula* were to have followed next after the Prerogative Instances.

[50] Instantiæ *vellicantes*, which pluck the Intellect by the sleeve. These facts, which force our attention to things which would otherwise, from their minuteness and subtilty, have escaped our notice.

[51] Referring to his Atomic Theory, cf. supra, I. 51.

[52] Bacon seems to have thought

parum croci etiam dolium aquæ colore inficiat; quod parum zibethi aut aromatis longe majus contentum aëris odore; quod exiguo suffitu tanta excitetur nubes fumi; quod sonorum tam accuratæ differentiæ, quales sint voces articulatæ, per aërem undequaque vehantur, atque per foramina et poros etiam ligni et aquæ (licet admodum extenuatæ) penetrent, quin etiam repercutiantur, idque tam distincte et velociter; quod lux et color, etiam tanto ambitu et tam perniciter, per corpora solida vitri, aquæ, et cum tanta et tam exquisita varietate imaginum permeent, etiam refringantur et reflectantur; quod magnes per corpora omnigena, etiam maxime compacta, operetur: sed (quod magis mirum est) quod in his omnibus, in medio adiaphoro (quale est aër) unius actio aliam non magnopere impediat; nempe, quod eodem tempore per spatia aëris devehantur et visibilium tot imagines[53]; et vocis articulatæ tot percussiones; et tot odores specificati, ut violæ, rosæ; etiam calor et frigus; et virtutes magneticæ; omnia (inquam) simul, uno alterum non impediente; ac si singula haberent vias et meatus suos proprios separatos, neque unum in alterum impingeret aut incurreret.

Solemus tamen utiliter hujusmodi *instantiis persecantibus* subjungere instantias, quas *metas persecationis* appellare consuevimus: veluti quod in iis, quæ diximus, una actio in diverso genere aliam non perturbet

this *Vermiculus* in the skin a living creature. Such is not the case. It is caused by the obstruction of the fountains or glands placed immediately under the skin, from which a minute pipe carries off the perspiration. Cf. supra, II. 34. By "figuram dissimilarem partium," I suppose, is meant a general figure distinct from the structure of its parts. This is a striking collection of examples, suggestive, but without any order.

[53] This refers to the Theory of Vision, which tried to account for its phenomena by films thrown off. See Herschel's Discourse, § 273.

aut impediat; cum tamen in eodem genere una aliam domet et extinguat: veluti, lux solis, lucem cicindelæ; sonitus bombardæ, vocem; fortior odor, delicatiorem; intensior calor, remissiorem; lamina ferri interposita inter magnetem et aliud ferrum, operationem magnetis. Verum de his quoque, inter *adminicula inductionis*, erit proprius dicendi locus.

XLIV.

Atque de instantiis, quæ juvant sensum, jam dictum est: quæ præcipui usus sunt ad partem informativam[54]. Informatio enim incipit a sensu. At universum negotium desinit in opera: atque quemadmodum illud principium, ita hoc finis rei est. Sequentur itaque instantiæ præcipui usus ad *partem operativam*. Eæ genere duæ sunt, numero septem: quas universas, generali nomine, *instantias practicas* appellare consuevimus. *Operativæ* autem *partis* vitia duo, totidemque dignitates instantiarum in genere. Aut enim fallit operatio, aut onerat nimis. Fallit operatio maxime (præsertim post diligentem naturarum inquisitionem) propter male determinatas et mensuratas corporum vires et actiones. Vires autem et actiones corporum circumscribuntur et mensurantur, aut per spatia loci, aut per momenta temporis, aut per unionem quanti, aut per prædominantiam virtutis: quæ quatuor, nisi fuerint probe et diligenter pensitata, erunt fortasse scientiæ speculatione quidem pulchræ, sed opere inactivæ. Instantias vero quatuor itidem, quæ huc referuntur, uno nomine *instantias mathematicas* vocamus, et *instantias mensuræ*.

[54] We come now to the third division of the Prerogatives of Instances — "Instances tending to Practice:" these are subdivided under two heads. (1) Those which correct the mistakes of the "pars operativa," or the Mathematical Instances; and (2) those which relieve "praxis" from too great a load of facts, and from being too laborious; which he terms *propitious* or *benevolent* Instances.

Onerosa autem fit praxis, vel propter misturam rerum inutilium: vel propter multiplicationem instrumentorum; vel propter molem materiæ et corporum, quæ ad aliquod opus requiri contigerint. Itaque eæ instantiæ in pretio esse debent, quæ aut dirigunt operativam ad ea quæ maxime hominum intersunt; aut quæ parcunt instrumentis; aut quæ parcunt materiæ sive supellectili. Eas autem tres instantias, quæ huc pertinent, uno nomine *instantias propitias* sive *benevolas* vocamus. Itaque de his septem instantiis jam sigillatim dicemus: atque cum iis partem illam de prærogativis sive dignitatibus instantiarum claudemus.

XLV.

Inter *prærogativas instantiarum*, ponemus loco vicesimo primo *instantias virgæ*, sive *radii*; quas etiam *instantias perlationis*, vel de *non ultra* appellare consuevimus[55]. Virtutes enim rerum et motus operantur et expediuntur per spatia, non indefinita aut fortuita, sed finita et certa; quæ ut in singulis naturis inquisitis teneantur et notentur, plurimum interest practicæ; non solum ad hoc ut non fallat, sed etiam ut magis sit aucta et potens. Etenim interdum datur virtutes producere, et distantias tanquam retrahere in propius; ut in perspicillis.

Atque plurimæ virtutes operantur et afficiunt tantum per tactum manifestum; ut fit in percussione corporum, ubi alterum non summovet alterum, nisi impellens impulsum tangat. Etiam medicinæ, quæ exterius applicantur, ut unguenta, emplastra, non exercent vires suas, nisi per tactum corporis. Denique objecta sen-

[55] "Cases in which things are to be measured in respect to their relation to *space*." Under this will come all Astronomical Instruments; the Hygrometer, the Sextant, &c. For the value and the standards of correct Measure, see Herschel's Discourse, § 115–124.

suum, tactus et gustus, non feriunt nisi contigua organis.

Sunt et aliæ virtutes quæ operantur ad distantiam, verum valde exiguam, quarum paucæ adhuc notatæ sunt, cum tamen plures sint quam homines suspicentur: ut (capiendo exempla ex vulgatis) cum succinum aut gagates trahunt paleas; bullæ approximatæ solvunt bullas; medicinæ nonnullæ purgativæ eliciunt humores ex alto, et hujusmodi. At virtus illa magnetica, per quam ferrum et magnes, vel magnetes, invicem coëunt, operatur intra orbem virtutis certum, sed parvum; ubi contra, si sit aliqua virtus magnetica emanans ab ipsa terra (paulo nimirum interiore) super acum ferream, quatenus ad verticitatem, operatio fiat ad distantiam magnam.

Rursus, si sit aliqua vis magnetica, quæ operetur per consensum inter globum terræ et ponderosa, aut inter globum lunæ et aquas maris, (quæ maxime credibilis videtur in fluxibus et refluxibus semi-menstruis[56]) aut inter cœlum stellatum et planetas, per quam evocentur et attollantur ad sua apogæa; hæc omnia operantur ad distantias admodum longinquas. Inveniuntur et quædam inflammationes sive conceptiones flammæ, quæ fiunt ad distantias bene magnas, in aliquibus materiis; ut referunt de naphtha Babylonica[57]. Calores etiam insinuant se per distantias amplas; quod etiam faciunt frigora: adeo ut habitantibus circa Canadam moles sive massæ glaciales, quæ abrumpuntur et natant per oceanum septentrionalem, et deferuntur per Atlanticum versus illas oras, percipiantur et incutiant frigora e lon-

[56] Cf. supr. II. 36. ex. 1. (note 7.)

[57] Naphtha is called "Babylonica" because a vast quantity of Bitumen was obtained from the neighbourhood of Babylon. It is also called "Oleum Medicum." Herodotus notices it, and calls it ἄσφαλτος. I. 179.

ginquo. Odores quoque (licet in his videatur semper esse quædam emissio corporea) operantur ad distantias notabiles; ut evenire solet navigantibus juxta litora Floridæ, aut etiam nonnulla Hispaniæ, ubi sunt sylvæ totæ ex arboribus limonum, aurantiorum[58], et hujusmodi plantarum odoratarum, aut frutices rorismarini, majoranæ, et similium. Postremo radiationes lucis et impressiones sonorum operantur scilicet ad distantias spatiosas.

Verum hæc omnia, utcunque operentur ad distantias parvas sive magnas, operantur certe ad finitas et naturæ notas, ut sit quiddam *non ultra;* idque pro rationibus, aut molis seu quanti corporum, aut vigoris et debilitatis virtutum; aut favoribus et impedimentis mediorum; quæ omnia in computationem venire et notari debent. Quinetiam mensuræ motuum violentorum, (quos vocant) ut missilium, tormentorum, rotarum, et similium, cum hæ quoque manifesto suos habeant limites certos, notandæ sunt.

Inveniuntur etiam quidam motus et virtutes contrariæ illis, quæ operantur per tactum et non ad distans; quæ operantur scilicet ad distans, et non ad tactum; et rursus, quæ operantur remissius ad distantiam minorem, et fortius ad distantiam majorem. Etenim visio non bene transigitur ad tactum, sed indiget medio et distantia. Licet meminerim, me audisse ex relatione cujusdam fide digni, quod ipse in curandis oculorum suorum cataractis (erat autem cura talis, ut immitteretur festuca[59] quædam parva argentea intra primam

[58] *Aurantiorum;* Oranges. It is an Arabian word *naranja*, and is said to be originally derived from the Sanscrit. (Notes and Queries, No. 278.) *Lemon* is also said to come from the Arabic. See Trench on English Past and Present. Lect. i.

[59] *Festuca* is the Greek *κάρφος*, a mote, or bit of straw; here, a needle. It is to be feared that the patient's declaration was not worth much.

oculi tunicam, quæ pelliculam illam cataractæ removeret et truderet in angulum oculi) clarissime vidisset festucam illam supra ipsam pupillam moventem. Quod utcunque verum esse possit, manifestum est, majora corpora non bene aut distincte cerni, nisi in cuspide coni, coëuntibus radiis objecti ad nonnullam distantiam. Quin etiam in senibus oculus melius cernit remoto objecto paulo longius, quam propius. In missilibus autem certum est, percussionem non fieri tam fortem ad distantiam nimis parvam, quam paulo post[59]. Hæc itaque et similia in mensuris motuum quoad distantias notanda sunt.

Est et aliud genus mensuræ localis motuum, quod non prætermittendum est. Illud vero pertinet ad motus non progressivos, sed sphæricos; hoc est, ad expansionem corporum in majorem sphæram, aut contractionem in minorem[60]. Inquirendum enim est inter mensuras istas motuum, quantam compressionem aut extensionem corpora (pro natura ipsorum) facile et libenter patiantur, et ad quem terminum reluctari incipiant, adeo ut ad extremum *non ultra* ferant; ut cum vesica inflata comprimitur, sustinet illa compressionem nonnullam aëris; sed si major fuerit, non patitur aër, sed rumpitur vesica.

At nos hoc ipsum subtiliore experimento magis exacte probavimus. Accepimus enim campanulam ex metallo, leviorem scilicet et tenuiorem, quali ad excipiendum salem utimur; eamque in pelvim aquæ immisimus, ita ut deportaret secum aërem, qui continebatur

[59] This is not the case. The Initial Velocity is the greatest, unless the ball be travelling downwards.

[60] This, (and especially the experiment of the egg,) shews that Bacon was ignorant of the pressure of the Atmosphere. The "Abhorrentia vacui" was believed in till after the time of Torricelli. Cf. supr. I. 66; and Herschel's Discourse, § 244—246.

in concavo usque ad fundum pelvis. Locaveramus autem prius globulum in fundo pelvis, super quem campanula imponenda esset. Quare illud eveniebat, ut si globulus ille esset minusculus (pro ratione concavi) reciperet se aër in locum minorem, et contruderetur solum, non extruderetur. Quod si grandioris esset magnitudinis, quam ut aër libenter cederet, tum aër majoris pressuræ impatiens, campanulam ex aliqua parte elevabat, et in bullis ascendebat.

Etiam ad probandum qualem extensionem (non minus quam compressionem) pateretur aër, tale quippiam practicavimus. Ovum vitreum accepimus, cum parvo foramine in uno extremo ovi. Aërem per foramen exsuctione forti attraximus, et statim digito foramen illud obturavimus; et ovum in aquam immersimus, et dein digitum removimus. Aër vero tensura illa per exsuctionem facta tortus, et magis quam pro natura sua dilatatus, ideoque se recipere et contrahere nitens (ita ut si ovum illud in aquam non fuisset immersum, aërem ipsum traxisset cum sibilo) aquam traxit ad tale quantum, quale sufficere posset ad hoc, ut aër antiquam recuperaret sphæram sive dimensionem.

Atque certum est, corpora tenuiora (quale est aër) pati contractionem nonnullam notabilem, ut dictum est: at corpora tangibilia (quale est aqua) multo ægrius, et ad minus spatium patiuntur compressionem. Qualem autem patiatur, tali experimento inquisivimus.

Fieri fecimus globum ex plumbo cavum, qui duas circiter pintas vinarias contineret; eumque satis per latera crassum; ut majorem vim sustineret. In illum aquam immisimus, per foramen alicubi factum; atque foramen illud, postquam globus aqua impletus fuisset, plumbo liquefacto obturavimus, ut globus deveniret

plane consolidatus. Dein globum forti malleo ad duo latera adversa complanavimus; ex quo necesse fuit aquam in minus contrahi, cum sphæra figurarum sit capacissima. Deinde, cum malleatio non amplius sufficeret, ægrius se recipiente aqua, molendino seu torculari usi sumus; ut tandem aqua, impatiens pressuræ ulterioris, per solida plumbi (instar roris delicati) exstillaret. Postea, quantum spatii per eam compressionem imminutum foret, computavimus: atque tantam compressionem passam esse aquam (sed violentia magna subactam) intelleximus.

At solidiora, sicca, aut magis compacta, qualia sunt lapides et ligna, necnon metalla, multo adhuc minorem compressionem aut extensionem, et fere imperceptibilem ferunt; sed vel fractione, vel progressione, vel aliis pertentationibus se liberant, ut in curvationibus ligni aut metalli, horologiis moventibus per complicationem laminæ, missilibus, malleationibus, et innumeris aliis motibus apparet. Atque hæc omnia cum mensuris suis in indagatione naturæ notanda et exploranda sunt; aut in certitudine sua, aut per æstimativas, aut per comparativas, prout dabitur copia.

XLVI.

Inter *prærogativas instantiarum* ponemus loco vicesimo secundo *instantias curriculi*, quas etiam *instantias ad aquam* appellare consuevimus[61]; sumpto vocabulo a clepsydris apud antiquos, in quas infundebatur aqua

[61] These Instances correspond to the last; with respect to *time*, however, and not to *space*. The Calculus is a good illustration of parts of both the chapters. Many of Bacon's suggestions and guesses have been verified: and what he himself counted as dreams, have been proved solid truths. But this chapter, in its illustration of the transmission of light from the Stars, and the way in which his "dubitatio plane monstrosa" was exploded, shew us how the ignorance of his day dragged him downwards.

loco arenæ. Eæ mensurant naturam per momenta temporis, quemadmodum *instantiæ virgæ* per gradus spatii. Omnis enim motus sive actio naturalis transigitur in tempore; alius velocius, alius tardius, sed utcunque momentis certis, et naturæ notis. Etiam illæ actiones, quæ subito videntur operari, et in ictu oculi (ut loquimur), deprehenduntur recipere majus et minus quoad tempus.

Primo itaque videmus, restitutiones corporum cœlestium fieri per tempora numerata; etiam fluxus et refluxus maris. Latio autem gravium versus terram, et levium versus ambitum cœli[62], fit per certa momenta, pro ratione corporis quod fertur, et medii. At velificationes navium, motus animalium, perlationes missilium, omnes fiunt itidem per tempora (quantum ad summas) numerabilia. Calorem vero quod attinet, videmus pueros per hyemem manus in flamma lavare, nec tamen uri; et joculatores vasa plena vino vel aqua per motus agiles et æquales vertere deorsum, et sursum recuperare, non effuso liquore; et multa hujusmodi. Nec minus ipsæ compressiones, et dilatationes, et eruptiones corporum fiunt, aliæ velocius, aliæ tardius, pro natura corporis et motus, sed per momenta certa. Quinetiam in explosione plurium bombardarum simul, quæ exaudiuntur quandoque ad distantiam triginta milliarium, percipitur sonus prius ab iis, qui prope absunt a loco ubi fit sonitus, quam ab iis, qui longe. At in visu (cujus actio est pernicissima) liquet etiam requiri ad eum actuandum momenta certa temporis; idque probatur ex iis, quæ propter motus velocitatem non cernuntur; ut ex latione pilæ ex sclopeto. Velocior enim est prætervolatio pilæ, quam impressio speciei ejus, quæ deferri poterat ad visum.

[62] Cf. supr. I. 66.

Atque hoc, cum similibus, nobis quandoque dubitationem peperit plane monstrosam; videlicet, utrum cœli sereni et stellati facies ad idem tempus cernatur quando vere existit, an potius aliquanto post; et utrum non sit (quatenus ad visum cœlestium) non minus tempus verum, et tempus visum, quam locus verus, et locus visus, qui notatur ab astronomis in parallaxibus. Adeo incredibile nobis videbatur, species sive radios corporum cœlestium per tam immensa spatia milliarium subito deferri posse ad visum; sed potius debere eas in tempore aliquo notabili delabi[63]. Verum illa dubitatio (quoad majus aliquod intervallum temporis inter tempus verum et visum) postea plane evanuit; reputantibus nobis jacturam illam infinitam, et diminutionem quanti, quatenus ad apparentiam inter corpus stellæ verum et speciem visam, quæ causatur a distantia; atque simul notantibus ad quantam distantiam (sexaginta scilicet ad minimum milliariorum) corpora, eaque tantum albicantia, subito hic apud nos cernantur; cum dubium non sit, lucem cœlestium, non tantum albedinis vividum colorem, verum etiam omnis flammæ (quæ apud nos nota est) lucem, quoad vigorem radiationis, multis partibus excedere; etiam immensa illa velocitas in ipso corpore, quæ cernitur in motu diurno, (quæ etiam viros graves ita obstupefecit, ut mallent credere motum terræ) facit motum illum ejaculationis radiorum ab ipsis (licet celeritate, ut diximus, mirabilem) magis credibilem. Maxime vero omnium nos movit, quod si interponeretur intervallum

[63] "The measurement of the Velocity of light, and the wonderful consequences arising from it, are the best commentaries on this passage, and the highest eulogy on its Author." Playfair, Disc. iii. Encycl. Brit. p. 468. Modern Physical Philosophers have delighted to give that honour to Bacon, which he so steadily refused to give to the great men of his own age.

temporis aliquod notabile inter veritatem et visum, foret ut species, per nubes interim orientes, et similes medii perturbationes, interciperentur sæpenumero, et confunderentur. Atque de mensuris temporum simplicibus hæc dicta sint.

Verum non solum quærenda est mensura motuum et actionum simpliciter, sed multo magis comparative: id enim eximii est usus, et ad plurima spectat. Atque videmus, flammam alicujus tormenti ignei citius cerni, quam sonitus audiatur; licet necesse sit, pilam prius aërem percutere, quam flamma, quæ pone erat, exire potuerit; fieri hoc autem propter velociorem transactionem motus lucis, quam soni. Videmus etiam, species visibiles a visu citius excipi, quam dimitti; unde fit, quod nervi fidium, digito impulsi, duplicentur, aut triplicentur, quoad speciem, quia species nova recipitur, antequam prior dimittatur; ex quo etiam fit, ut annuli rotati videantur globosi, et fax ardens, noctu velociter portata, conspiciatur caudata. Etiam ex hoc fundamento inæqualitatis motuum quoad velocitatem, excogitavit Galilæus causam fluxus et refluxus maris, rotante terra velocius, aquis tardius; ideoque accumulantibus se aquis in sursum, et deinde per vices se remittentibus in deorsum; ut demonstratur in vase aquæ incitatius movente. Sed hoc commentus est concesso non concessibili (quod terra nempe moveatur); ac etiam non bene informatus de oceani motu sexhorario.

At exemplum hujus rei, de qua agitur, videlicet de comparativis mensuris motuum, neque solum rei ipsius, sed et usus insignis ejus, (de quo paulo ante loquuti sumus) eminet in cuniculis subterraneis, in quibus collocatur pulvis pyrius; ubi immensæ moles terræ, ædificiorum, et similium, subvertuntur, et in altum jaciun-

tur, a pusilla quantitate pulveris pyrii[64]. Cujus causa pro certa illa est, quod motus dilatationis pulveris, qui impellit, multis partibus sit pernicior quam motus gravitatis, per quem fieri possit aliqua resistentia; adeo ut primus motus perfunctus sit, antequam motus adversus inceperit; ut in principiis nullitas quædam sit resistentiæ. Hinc etiam fit, quod in omni missili, ictus non tam robustus, quam acutus et celer, ad perlationem potissimum valeat. Neque etiam fieri potuisset, ut parva quantitas spiritus animalis in animalibus, præsertim in tam vastis corporibus, qualia sunt balænæ aut elephanti, tantam molem corpoream flecteret et regeret; nisi propter velocitatem motus spiritus, et hebetudinem corporeæ molis, quatenus ad expediendam suam resistentiam.

Denique, hoc unum ex præcipuis fundamentis est experimentorum magicorum, de quibus mox dicemus; ubi scilicet parva moles materiæ longe majorem superat, et in ordinem redigit: hoc inquam; si fieri possit anteversio motuum per velocitatem unius, antequam alter se expediat.

Postremo, hoc ipsum *prius* et *posterius* in omni actione naturali notari debet; veluti quod in infusione rhabarbari eliciatur purgativa vis prius, astrictiva post; simile quiddam etiam in infusione violarum in acetum experti sumus; ubi primo excipitur suavis et delicatus floris odor; post, pars floris magis terrea, quæ odorem confundit. Itaque si infundantur violæ per diem integrum, odor multo languidius excipitur: quod si infundantur per partem quartam horæ tantum, et extrahantur; et (quia paucus est spiritus odoratus, qui subsistit

[64] In describing Blasting, Bacon confuses the resistance of inertness with that of gravity.

in viola) infundantur post singulas quartas horæ violæ novæ et recentes ad sexies; tum demum nobilitatur infusio, ita ut licet non manserint violæ, utcunque renovatæ, plus quam ad sesquihoram; tamen permanserit odor gratissimus, et viola ipsa non inferior, ad annum integrum. Notandum tamen est, quod non se colligat odor ad vires suas plenas, nisi post mensem ab infusione. In distillationibus vero aromatum maceratorum in spiritu vini patet, quod surgat primo phlegma aqueum et inutile, deinde aqua plus habens ex spiritu vini, deinde post aqua plus habens ex aromate. Atque hujus generis quamplurima inveniuntur in distillationibus notatu digna. Verum hæc sufficiant ad exempla.

XLVII.

Inter *prærogativas instantiarum* ponemus loco vicesimo tertio *instantias quanti*, quas etiam *doses naturæ* (sumpto vocabulo a medicinis) vocare consuevimus[65]. Eæ sunt quæ mensurant virtutes per *quanta* corporum,

[65] Instantiæ *quanti*—giving the ratio of Quantity to Power, however measured. This class would be peculiarly useful for Chemistry and Medicine: for the exactness of such proportions is the thing which renders Chemistry a true science. See Herschel's Discourse, § 115, 116. and § 351. "Calculation" is ranked by Condorcet with Observation and Experiment, when he is speaking of Bacon's "revelation of the true method of studying Nature." But Calculation, and quantitative Measurement, are instruments of discovery no how analogous to the other two; and as Dugald Stewart says, "Calculation is only one of the many Arts by which we are enabled to give a greater degree of accuracy to their results." He goes on to say, "The advantages, which Natural Philosophy has derived, in modern times, from the Arithmetical precision thus given to scientific details, must be allowed to be immense; and they would be well entitled to an ample illustration in a system of Inductive Logic." D. Stewart's Philosophy of the Human Mind, part II. chap. iv. sect. 1. (note). The statement respecting the velocity of descent of bodies is interesting, as shewing that though Bacon does not mention Galileo, he was willing to accept some of his principles. For Galileo was the first person who boldly denied the Aristotelian thesis that bodies of unequal weight fall equal distances in unequal times; and proved his denial by the famous experiment of letting a 10lb. and an 1lb. weight fall from the leaning Tower of Pisa.

et indicant quid *quantum corporis* faciat ad *modum virtutis*. Ac primo sunt quædam virtutes, quæ non subsistunt nisi in *quanto cosmico*, hoc est, tali *quanto* quod habeat consensum tum configuratione et fabrica universi. Terra enim stat; partes ejus cadunt. Aquæ in maribus fluunt et refluunt; in fluviis minime, nisi per ingressum maris. Deinde etiam omnes fere virtutes particulares secundum *multum* aut *parum* corporis operantur. Aquæ largæ non facile corrumpuntur; exiguæ cito. Mustum et cervisia maturescunt longe citius, et fiunt potabilia in utribus parvis, quam in doliis magnis. Si herba ponatur in majore portione liquoris, fit infusio, magis quam imbibitio: si in minore, fit imbibitio, magis quam infusio. Aliud igitur erga corpus humanum est balneum, aliud levis irroratio. Etiam parvi rores in aëre nunquam cadunt, sed dissipantur, et cum aëre incorporantur. Et videre est in anhelitu super gemmas, parum illud humoris, quasi nubeculam vento dissipatam, continuo solvi. Etiam frustum ejusdem magnetis non trahit tantum ferri, quantum magnes integer. Sunt etiam virtutes, in quibus parvitas *quanti* magis potest; ut in penetrationibus, stylus acutus citius penetrat, quam obtusus; adamas punctuatus sculpit in vitro, et similia.

Verum non hic morandum est in indefinitis, sed etiam de *rationibus quanti* corporis erga modum virtutis inquirendum. Proclive enim foret credere, quod rationes quanti rationes virtutis adæquarent; ut si pila plumbea unius unciæ caderet in tali tempore, pila unciarum duarum deberet cadere duplo celerius, quod falsissimum est; nec eædem rationes in omni genere virtutum valent, sed longe diversæ. Itaque hæ mensuræ ex rebus ipsis petendæ sunt, et non ex verisimilitudine, aut conjecturis.

Denique in omni inquisitione naturæ, *quantum* corporis requiratur ad aliquod effectum, tanquam dosis, notandum; et cautiones de *nimis* et *parum* aspergendæ.

XLVIII.

Inter *prærogativas instantiarum*, ponemus loco vicesimo quarto *instantias luctæ*, quas etiam *instantias prædominantiæ* appellare consuevimus[66]. Eæ indicant prædominantiam et cessionem virtutum ad invicem; et quæ ex illis sit fortior et vincat, quæ infirmior et succumbat. Sunt enim motus et nixus corporum compositi, decompositi, et complicati, non minus quam corpora ipsa. Proponemus igitur primum species præcipuas motuum sive virtutum activarum; ut magis perspicua sit ipsarum comparatio in robore, et exinde demonstratio atque designatio *instantiarum luctæ* et *prædominantiæ*.

(1.) Motus primus sit motus *antitypiæ*[67] materiæ, quæ inest in singulis portionibus ejus; per quem plane annihilari non vult; ita ut nullum incendium, nullum pondus, aut depressio, nulla violentia, nulla denique ætas aut diuturnitas temporis possit redigere aliquam vel minimam portionem materiæ in nihilum, quin illa et sit aliquid, et loci aliquid occupet, et se, (in qualicunque necessitate ponatur) vel formam mutando vel

[66] By an oversight Bacon gives the same second name to these Instances as he does to the third class, viz. "Instantiæ ostensivæ — quas etiam elucescentias, sive instantias liberatas et *prædominantes*, appellare consuevimus." II. 24. In calling these instances of *Resistance*, Bacon does well enough: but when he gives to them all the generic name of *Motus*, it is not so well. For he uses the term in a very vague and improper manner — including under it tendencies to resistance and *inertia*, and the resistance to annihilation which is found in all substances. Motion (so far as so simple an operation can be defined) is rightly defined by Epicurus as "Change of Place."

[67] *Antitypiæ*. The indestructibility of Matter—a property (as far as we know) universal.

locum, liberet; vel, (si non detur copia) ut est, subsistat; neque unquam res eo deveniat, ut aut nihil sit, aut nullibi. Quem motum schola (quæ semper fere et denominat et definit res, potius per effectus et incommoda, quam per causas interiores) vel denotat per illud axioma, quod *duo corpora non possint esse in uno loco;* vel vocat motum, *ne fiat penetratio dimensionum*[68]. Neque hujus motus exempla proponi consentaneum est: inest enim omni corpori.

(2.) Sit motus secundus, motus (quem appellamus) *nexus*, per quem corpora non patiuntur se ulla ex parte sui dirimi a contactu alterius corporis, ut quæ mutuo nexu et contactu gaudeant. Quem motum schola vocat motum *ne detur vacuum*[69]: veluti cum aqua attrahitur sursum exsuctione, aut per fistulas; caro per ventosas; aut cum aqua sistitur, nec effluit in hydriis perforatis, nisi os hydriæ ad immittendum aërem aperiatur: et innumera id genus.

(3.) Sit motus tertius, motus (quem appellamus) *libertatis*[70]; per quem corpora se liberare nituntur a pressura aut tensura præternaturali, et restituere se in dimensum corpori suo conveniens. Cujus motus etiam innumera sunt exempla: veluti (quatenus ad liberationem a pressura) aquæ in natando, aëris in volando; aquæ in remigando, aëris in undulationibus ventorum, laminæ in horologiis. Nec ineleganter se ostendit motus aëris compressi in sclopetis ludicris puerorum, cum alnum aut simile quiddam excavant, et infarciunt frusto alicujus radicis succulentæ, vel similium, ad utrosque fines; deinde per embolum trudunt radicem vel hujusmodi farcimentum in foramen alterum: unde emittitur et ejicitur radix cum sonitu ad foramen alte-

[68] Cf. supra, II. 36. Inst. 6.

[69] Cf. supra, I. 66.

[70] "Libertatis:" i. e. the operation of Elasticity.

rum, idque antequam tangatur a radice, aut farcimento citimo, aut embolo. Quatenus vero ad liberationem a tensura, ostendit se hic motus in aëre post exuctionem in ovis vitreis remanente, in chordis, in corio, et panno, resilientibus post tensuras suas, nisi tensuræ illæ per moram invaluerint, &c. Atque hunc motum schola sub nomine motus ex *forma elementi* innuit: satis quidem inscite, cum hic motus non tantum ad aërem, aquam, aut flammam pertineat, sed ad omnem diversitatem consistentiæ: ut ligni, ferri, plumbi, panni, membranæ, &c. in quibus, singula corpora suæ habent dimensionis modulum; et ab eo ægre ad spatium aliquod notabile abripiuntur. Verum quia motus iste libertatis omnium est maxime obvius, et ad infinita spectans, consultum fuerit eum bene et perspicue distinguere. Quidam enim valde negligenter confundunt hunc motum cum gemino illo motu *antitypiæ* et *nexus*; liberationem scilicet a pressura, cum motu *antitypiæ*; a tensura, cum motu *nexus*: ac si ideo cederent aut se dilatarent corpora compressa, ne sequeretur *penetratio dimensionum*; ideo resilirent et contraherent se corpora tensa, ne sequeretur *vacuum*. Atqui si aër compressus se vellet recipere in densitatem aquæ, aut lignum in densitatem lapidis, nil opus foret *penetratione dimensionum*: et nihilominus longe major posset esse compressio illorum, quam illa ullo modo patiuntur. Eodem modo si aqua se dilatare vellet in raritatem aëris, aut lapis in raritatem ligni, non opus foret *vacuo*: et tamen longe major posset fieri extensio eorum, quam illa ullo modo patiuntur. Itaque non reducitur res ad *penetrationem dimensionum*, et *vacuum*, nisi in ultimitatibus condensationis et rarefactionis: cum tamen isti motus longe citra eas sistant et versentur; neque aliud sint, quam desideria corporum conservandi se in con-

sistentiis suis, (sive, si malint, in formis suis) nec ab iis recedendi subito, nisi per modos suaves, ac per consensum alterentur. At longe magis necessarium est (quia multa secum trahit) ut intimetur hominibus, motum violentum[71] (quem nos *mechanicum*, Democritus, qui in motibus suis primis expediendis etiam infra mediocres philosophos ponendus est, motum *plagæ* vocavit[72]) nil aliud esse quam motum libertatis, scilicet a compressione ad relaxationem. Etenim in omni sive simplici protrusione, sive volatu per aërem, non fit summotio aut latio localis, antequam partes corporis præternaturaliter patiantur et comprimantur ab impellente. Tum vero partibus aliis alias per successionem trudentibus, fertur totum; nec solum progrediendo, sed etiam rotando simul; ut etiam hoc modo partes se liberare, aut magis ex æquo tolerare possint. Atque de hoc motu hactenus.

(4.) Sit motus quartus, motus cui nomen dedimus motus *hyles*[73]: qui motus antistrophus est quodammodo motui, de quo diximus, libertatis. Etenim in motu libertatis corpora novum dimensum, sive novam sphæram, sive novam dilatationem aut contractionem (hæc enim verborum varietas idem innuit) exhorrent, respuunt, fugiunt, et resilire ac veterem consistentiam recuperare totis viribus contendunt. At contra in hoc motu *hyles*, corpora novam sphæram sive dimensum appetunt; atque ad illud libenter et propere, et quandoque

[71] Motus violens et naturalis. Cf. supr. I. 66.

[72] *Plagæ*. Cf. supr. II. 35. (note 2.)

[73] *Hyles*, ὕλης. The capacity of expansion—the tendency of matter, under certain circumstances, to enlarge its bulk—as is to be seen in the case of Heat, or of explosive substances. The account of the origin of Stalactites is a curious instance of dogmatism without any truth. Southey, Thalaba II. 25, alludes to a similar belief that crystals are ice long congealed; and in his notes quotes as his authority Camillus Leonardus in his "Mirror of Stones."

valentissimo nixu (ut in pulvere pyrio) aspirant. Instrumenta autem hujus motus, non sola certe, sed potentissima, aut saltem frequentissima, sunt calor et frigus. Exempli gratia: aër, si per tensuram (velut per exsuctionem in ovis vitreis) dilatetur, magno laborat desiderio seipsum restituendi. At admoto calore, e contra appetit dilatari, et concupiscit novam sphæram, et transit et migrat in illam libenter, tanquam in novam formam (ut loquuntur.) Nec post dilatationem nonnullam de reditu curat, nisi per admotionem frigidi ad eam invitetur; quæ non reditus est, sed transmutatio repetita. Eodem modo et aqua, si per compressionem arctetur, recalcitrat; et vult fieri qualis fuit, scilicet latior. At si interveniat frigus intensum et continuatum, mutat se sponte sua et libenter in condensationem glaciei: atque si plane continuetur frigus, nec a teporibus interrumpatur (ut fit in speluncis et cavernis paulo profundioribus), vertitur in crystallum, aut materiam similem, nec unquam restituitur.

(5.) Sit motus quintus, motus *continuationis*[74]: intelligimus autem non continuationis simplicis et primariæ, cum corpore aliquo altero (nam ille est motus *nexus*); sed continuationis sui, in corpore certo. Certissimum enim est, quod corpora omnia solutionem continuitatis exhorreant, alia magis, alia minus, sed omnia aliquatenus. Nam ut in corporibus duris (veluti chalybis, vitri) reluctatio contra discontinuationem est maxime robusta et valida; ita etiam in liquoribus, ubi cessare aut languere saltem videtur motus ejusmodi, tamen non prorsus reperitur privatio ejus; sed plane

[74] This again is no *motion* at all, but the effect of Attraction of cohesion, by which the particles of the same mass are kept together. See (for the illustrations) supr. II. 25. "Clandestine Instances of *Consistency*."

inest ipsis in gradu tanquam infimo, et prodit se in experimentis plurimis; sicut in bullis, in rotunditate guttarum, in filis tenuioribus stillicidiorum, et in sequacitate corporum glutinosorum, et ejusmodi. Sed maxime omnium se ostendit appetitus iste, si discontinuatio tentetur usque ad fractiones minores. Nam in mortariis, post contusionem ad certum gradum, non amplius operatur pistillum: aqua non subintrat rimas minores: quin et ipse aër, non obstante subtilitate corporis ipsius, poros vasorum paulo solidiorum non pertransit subito, nec nisi per diuturnam insinuationem.

(6.) Sit motus sextus, motus quem nominamus motum *ad lucrum*, sive motum *indigentiæ*[75]. Is est, per quem corpora, quando versantur inter plane heterogenea et quasi inimica, si forte nanciscantur copiam aut commoditatem evitandi illa heterogenea, et se applicandi ad magis cognata, (licet illa ipsa cognata talia fuerint, quæ non habeant arctum consensum cum ipsis) tamen statim ea amplectuntur, et tanquam potiora malunt; et lucri loco (unde vocabulum sumpsimus) hoc ponere videntur, tanquam talium corporum indiga. Exempli gratia: aurum, aut aliud metallum foliatum, non delectatur aëre circumfuso. Itaque si corpus aliquod tangibile et crassum nanciscatur, (ut digitum, papyrum, quidvis aliud) adhæret statim, nec facile divellitur. Etiam papyrus, aut pannus, et hujusmodi, non bene se habent cum aëre, qui inseritur et commistus est in ipsorum poris. Itaque aquam aut liquorem

[75] The motion of Preference; i. e. the tendency bodies have to unite with some substances rather than others. Under this head might be placed all Chemical Affinities—(e. g. that of Oxygen in the Air for Iron.) Bacon of course knew nothing of these, or of Capillary Attraction, with which he seems to confound this elective quality of Matter. The old system of Sympathies and Antipathies had great weight with him: though he was aware of many of the dreams connected with them.

libenter imbibunt, et aërem exterminant. Etiam saccharum, aut spongia infusa in aquam aut vinum, licet pars ipsorum emineat et longe attollatur supra vinum aut aquam, tamen aquam aut vinum paulatim et per gradus attrahunt in sursum [76].

Unde optimus canon sumitur aperturæ et solutionum corporum. Missis enim corrosivis et aquis fortibus, quæ viam sibi aperiunt; si possit inveniri corpus proportionatum et magis consentiens et amicum corpori alicui solido, quam illud cum quo tanquam per necessitatem commiscetur; statim se aperit et relaxat corpus, et illud alterum intro recipit, priore excluso aut summoto. Neque operatur, aut potest, iste *motus ad lucrum* solummodo ad tactum. Nam electrica operatio (de qua Gilbertus et alii post eum tantas excitarunt fabulas) non alia est quam corporis per fricationem levem excitati appetitus, qui aërem non bene tolerat, sed aliud tangibile mavult, si reperiatur in propinquo [77].

(7.) Sit motus septimus, motus (quem appellamus) *congregationis majoris* [78]; per quem corpora feruntur ad massas connaturalium suorum: gravia ad globum terræ; levia ad ambitum cœli. Hunc schola nomine *motus naturalis* insignivit, levi contemplatione: quia scilicet nil spectabile erat ab extra, quod eum motum cieret (itaque rebus ipsis innatum atque insitum putavit), aut forte quia non cessat. Nec mirum: semper

[76] This arises from the Capillary Tubes, under the influence of Attraction.

[77] This is audacious enough, and "corporis per fricationem levem excitati appetitus" &c. is likely to throw but little light on the truth, in comparison with Gilbert's careful and truthful experiments.

[78] This is the tendency which distinct bodies of the same substance have to coalesce when placed near one another: as when two drops of Quicksilver coming close to one another are mutually attracted and fall into one. Cf. supr. I. 66.

enim præsto sunt cœlum et terra; cum e contra causæ et origines plurimorum ex reliquis motibus interdum absint, interdum adsint. Itaque hunc, quia non intermittit, sed cæteris intermittentibus statim occurrit, perpetuum et proprium; reliquos, ascititios posuit. Est autem iste motus revera satis infirmus et hebes, tanquam is, qui (nisi sit moles corporis major) cæteris motibus, quandiu operantur, cedat et succumbat. Atque cum hic motus hominum cogitationes ita impleverit, ut fere reliquos motus occultaverit; tamen parum est quod homines de eo sciunt, sed in multis circa illum erroribus versantur.

(8.) Sit motus octavus, motus *congregationis minoris*[79]; per quem partes homogeneæ in corpore aliquo separant se ab heterogeneis, et coëunt inter sese; per quem etiam corpora integra ex similitudine substantiæ se amplectuntur et fovent, et quandoque ad distantiam aliquam congregantur, attrahuntur, et conveniunt: veluti cum in lacte flos lactis post moram aliquam supernatat; in vino fæces et tartarum subsidunt. Neque enim hæc fiunt per motum gravitatis et levitatis tantum, ut aliæ partes summitatem petant, aliæ ad imum vergant; sed multo magis per desiderium homogeneorum inter se coëundi, et se uniendi. Differt autem iste motus a motu *indigentiæ*, in duobus. Uno, quod in motu *indigentiæ* sit stimulus major naturæ malignæ et contrariæ: at in hoc motu (si modo impedimenta et vincula absint (uniuntur partes per amicitiam, licet absit natura alièna quæ litem moveat. Altero, quod arctior sit unio, et tanquam majore cum delectu. In

[79] Specific gravity accounts for most of these cases, where homogeneous particles combine after mixture. Other chemical means may be made use of; as (e.g.) when carbonic acid introduced into lime-water causes the formation of Carbonate of Lime.

illo enim, modo evitetur corpus inimicum, corpora etiam non admodum cognata concurrunt: at in hoc coëunt substantiæ, germana plane similitudine devinctæ; et conflantur tanquam in unum. Atque hic motus omnibus corporibus compositis inest; et se facile conspiciendum in singulis daret, nisi ligaretur et frænaretur per alios corporum appetitus et necessitates, quæ istam coitionem disturbant.

Ligatur autem motus iste plerumque tribus modis: torpore corporum; fræno corporis dominantis; et motu externo. Ad torporem corporum quod attinet; certum est, inesse corporibus tangibilibus pigritiam quandam secundum magis et minus, et exhorrentiam motus localis; ut nisi excitentur, malint statu suo (prout sunt) esse contenta, quam in melius se expedire. Discutitur autem iste torpor triplici auxilio: aut per calorem, aut per virtutem alicujus cognati corporis eminentem, aut per motum vividum et potentem. Atque primo quoad auxilium caloris: hinc fit, quod calor pronuntietur esse illud quod *separet heterogenea, congreget homogenea.* Quam definitionem Peripateticorum merito derisit Gilbertus; dicens, eam esse perinde ac si quis diceret ac definiret hominem illud esse, quod serat triticum, et plantet vineas: esse enim definitionem tantum per effectus, eosque particulares. Sed adhuc magis culpanda est illa definitio; quia etiam effectus illi (quales quales sunt) non sunt ex proprietate caloris, sed tantum per accidens, (idem enim facit frigus, ut postea dicemus) nempe ex desiderio partium homogenearum coëundi, adjuvante tantum calore ad discutiendum torporem, qui torpor desiderium illud antea ligaverat. Quoad vero auxilium virtutis inditæ a corpore cognato; illud mirabiliter elucescit in magnete armato, qui excitat in ferro virtutem detinendi ferrum per similitu-

dinem substantiæ, discusso torpore ferri per virtutem magnetis. Quoad vero auxilium motus, conspicitur illud in sagittis ligneis, cuspide etiam lignea: quæ altius penetrant in alia ligna, quam si fuissent armatæ ferro, per similitudinem substantiæ, discusso torpore ligni per motum celerem: de quibus duobus experimentis etiam in aphorismo de *instantiis clandestinis* diximus[80].

Ligatio vero motus *congregationis minoris*, quæ fit per frænum corporis dominantis, conspicitur in solutione sanguinis et urinarum per frigus. Quamdiu enim repleta fuerint corpora illa spiritu agili, qui singulas eorum partes cujuscunque generis, ipse ut dominus totius, ordinat et cohibet; tamdiu non coëunt heterogenea propter frænum: sed postquam ille spiritus evaporaverit, aut suffocatus fuerit per frigus, tum solutæ partes a fræno, coëunt secundum desiderium suum naturale. Atque ideo fit, ut omnia corpora, quæ continent spiritum acrem, (ut sales, et hujusmodi) durent et non solvantur, ob frænum permanens et durabile spiritus dominantis et imperiosi.

Ligatio vero motus *congregationis minoris*, quæ fit per motum externum, maxime conspicitur in agitationibus corporum, per quas arcetur putrefactio. Omnis enim putrefactio fundatur in congregatione homogeneorum; unde paulatim fit corruptio prioris (quam vocant) formæ, et generatio novæ. Nam putrefactionem, quæ sternit viam ad generationem novæ formæ, præcedit solutio veteris; quæ est ipsa coitio ad homogeneam. Ea vero, si non impedita fuerit, fit solutio simplex; sin occurrant varia quæ obstant, sequuntur putrefactiones, quæ sunt rudimenta generationis novæ.

[80] Supr. II. 25.

Quod si (id quod nunc agitur) fiat agitatio frequens per motum externum: tum vero motus iste coitionis (qui est delicatus et mollis, et indiget quiete ab externis) disturbatur et cessat; ut fieri videmus in innumeris: veluti, cum quotidiana agitatio aut profluentia aquæ arceat putrefactionem; venti arceant pestilentiam aëris; grana in granariis versa et agitata maneant pura; omnia denique agitata exterius non facile putrefiant interius.

Superest ut non omittatur coitio illa partium corporum, unde fit præcipue induratio et desiccatio. Postquam enim spiritus, aut humidum in spiritum versum, evolaverit in aliquo corpore porosiore, (ut in ligno, osse, membrana, et hujusmodi) tum partes crassiores majore nixu contrahuntur et coëunt, unde sequitur induratio aut desiccatio: quod existimamus fieri, non tam ob motum *nexus*, ne detur vacuum, quam per motum istum amicitiæ et unionis.

Ad coitionem vero ad distans quod attinet, ea infrequens est et rara: et tamen in pluribus inest, quam quibus observatur. Hujus simulacra sunt, cum bulla solvit bullam; medicamenta ex similitudine substantiæ trahunt humores; chorda in diversis fidibus ad unisonum moveat chordam; et hujusmodi. Etiam in spiritibus animalium hunc motum vigere existimamus, sed plane incognitum. At eminet certe in magnete, et ferro excito. Cum autem de motibus magnetis loquimur, distinguendi plane sunt. Quatuor enim virtutes sive operationes sunt in magnete, quæ non confundi, sed separari debent; licet admiratio hominum et stupor eas commiscuerit. Una, coitionis magnetis ad magnetem, vel ferri ad magnetem, vel ferri exciti ad ferrum. Secunda, verticitatis ejus ad septentriones et austrum, atque simul declinationis ejus. Tertia, pene-

trationis ejus per aurum, vitrum, lapidem, omnia. Quarta, communicationis virtutis ejus de lapide in ferrum, et de ferro in ferrum, absque communicatione substantiæ. Verum hoc loco de prima virtute ejus tantum loquimur, videlicet coitionis. Insignis etiam est motus coitionis argenti vivi et auri; adeo ut aurum alliciat argentum vivum licet confectum in unguenta: atque operarii inter vapores argenti vivi soleant tenere in ore frustum auri ad colligendas emissiones argenti vivi, alias crania et ossa eorum invasuras; unde etiam frustum illud paulo post albescit. Atque de motu *congregationis minoris* hæc dicta sint.

(9.) Sit motus nonus, *motus magneticus*[81]; qui licet sit ex genere motus *congregationis minoris*, tamen si operetur ad distantias magnas, et super massas rerum magnas, inquisitionem meretur separatam; præsertim si nec incipiat a tactu, quemadmodum plurimi, nec perducat actionem ad tactum, quemadmodum omnes motus congregativi; sed corpora tantum elevet, aut ea intumescere faciat, nec quicquam ultra. Nam si luna attollat aquas, aut turgescere aut intumescere faciat humida; aut cœlum stellatum attrahat planetas versus sua apogæa; aut sol alliget astra Veneris et Mercurii, ne longius absint a corpore ejus, quam ad distantiam certam; videntur hi motus nec sub *congregatione majore*, nec sub *congregatione minore* bene collocari, sed esse tanquam congregativa media et imperfecta, ideoque speciem debere constituere propriam.

(10.) Sit motus decimus, *motus fugæ*[82]; motus sci-

[81] This is an attempt at explanation of some of the probable truths (to Bacon only probable) of Gravity, by Magnetism.

[82] This is a rough description of that which is now known as *Repulsion*. Newton's experiments proved that a lens placed on a flat glass remained at a distance of $\frac{1}{137}$th of an inch from it. The cause of this Repulsion may be the subtle substance *Heat*, if Heat be indeed ma-

licet motui *congregationis minoris* contrarius; per quem corpora ex antipathia fugiunt et fugant inimica, seque ab illis separant, aut cum illis miscere se recusant. Quamvis enim videri possit in aliquibus hic motus esse motus tantum per accidens, aut per consequens, respectu motus *congregationis minoris*, quia nequeunt coire homogenea, nisi heterogeneis exclusis et remotis: tamen ponendus est motus iste per se, et in speciem constituendus, quia in multis appetitus *fugæ* cernitur magis principalis, quam appetitus coitionis.

Eminet autem hic motus insigniter in excretionibus animalium; nec minus etiam in sensuum nonnullorum odiosis objectis, præcipue in olfactu et gustu. Odor enim fœtidus ita rejicitur ab olfactu, ut etiam inducat in os stomachi motum expulsionis per consensum; sapor amarus et horridus ita rejicitur a palato aut gutture, ut inducat per consensum capitis conquassationem et horrorem. Veruntamen etiam in aliis locum habet iste motus. Conspicitur enim in antiperistasibus[83] nonnullis; ut in aëris media regione, cujus frigora videntur esse rejectiones naturæ frigidæ ex confiniis cœlestium; quemadmodum etiam videntur magni illi fervores et inflammationes, quæ inveniuntur in locis subterraneis, esse rejectiones naturæ calidæ ab interioribus terræ. Calor enim et frigus, si fuerint in quanto minore, se invicem perimunt; sin fuerint in massis majoribus, et tanquam justis exercitibus, tum vero per conflictum se locis invicem summovent, et ejiciunt. Etiam tradunt,

terial. And Boscovich holds that the atoms of which a body is composed act on each other with a force differing in intensity and in kind according to the distance. The best and "glaring" Instance of Repulsion would be the action of the similar poles of two Magnets. See account of the Nov. Org. published in the Library of Useful Knowledge, No. 2. p. 28–29.

[83] Cf. supr. II. 12. Inst. 24; and II. 27.

cinnamomum et odorifera, sita juxta latrinas et loca fœtida, diutius odorem retinere, quia recusant exire et commisceri cum fœtidis. Certe argentum vivum, quod alias se reuniret in corpus integrum, prohibetur per salivam hominis, aut axungiam[84] porci, aut terebinthinam, et hujusmodi, ne partes ejus coëant; propter malum consensum quem habent cum hujusmodi corporibus; a quibus undique circumfusis se retrahunt; adeo ut fortior sit earum *fuga* ab istis interjacentibus, quam desiderium uniendi se cum partibus sui similibus: id quod vocant *mortificationem* argenti vivi. Etiam quod oleum cum aqua non misceatur, non tantum in causa est differentia levitatis; sed malus ipsorum consensus: ut videre est in spiritu vini, qui cum levior sit oleo, tamen se bene miscet cum aqua. Et maxime omnium insignis est motus *fugæ* in nitro, et hujusmodi corporibus crudis, quæ flammam exhorrent: ut in pulvere pyrio, argento vivo, necnon in auro. *Fuga* vero ferri ab altero polo magnetis a Gilberto bene notatur non esse *fuga* propria, sed conformitas, et coitio ad situm magis accommodatum.

(11.) Sit motus undecimus, *motus assimilationis*[85], sive *multiplicationis* sui, sive etiam *generationis simplicis*. *Generationem* autem *simplicem* dicimus non corporum integralium, ut in plantis, aut animalibus; sed corporum similarium. Nempe per hunc motum corpora similaria vertunt corpora alia affinia, aut saltem bene disposita et præparata, in substantiam et naturam

[84] *Axungia*, pig's lard. Literally the grease used for axles of wheels, (axis, ungere.)

[85] Motus 11–13 are all under the same class.

This *motus assimilationis* is the principle by which Chemical Agents disengage the particles and elements akin to themselves from other bodies, and assimilate them; as in the case of flame which consumes the Oxygen in various bodies —or the stomach, which accepts and applies whatever can be turned into Blood, &c.

suam: ut flamma, quæ super halitus et oleosa multiplicat se, et generat novam flammam; aër, qui super aquam et aquea multiplicat se, et generat novum aërem: spiritus vegetabilis et animalis, qui super tenuiores partes, tam aquei quam oleosi, in alimentis suis multiplicat se, et generat novum spiritum; partes solidæ plantarum et animalium, veluti folium, flos, caro, os, et sic de cæteris, quæ singulæ ex succis alimentorum assimilant, et generant substantiam successivam et epiusiam[86]. Neque enim quenquam cum Paracelso[87] delirare juvet, qui (distillationibus suis scilicet occæcatus) nutritionem per separationem tantum fieri voluit; quodque in pane vel cibo lateat oculus, nasus, cerebrum, jecur; in succo terræ radix, folium, flos. Etenim sicut faber ex rudi massa lapidis vel ligni, per separationem et rejectionem superflui, educit folium, florem, oculum, nasum, manum, pedem, et similia; ita Archæum illum fabrum internum ex alimento per separationem et rejectionem educere singula membra et partes, asserit ille. Verum missis nugis, certissimum est, partes singulas tam similares, quam organicas, in vegetabilibus et animalibus, succos alimentorum suorum fere communes, aut non multum diversos, primo attrahere cum nonnullo delectu, deinde assimilare, et vertere in naturam suam. Neque *assimilatio* ista, aut *generatio simplex* fit solum in corporibus animatis; verum et inanimata ex hac re participant; ve-

[86] Epiusia — ἐπιουσία — daily, or ever-renewed. The word is so used in the Lord's Prayer, St. Matt. vi. 11.

[87] Theophrastus Paracelsus died A. D. 1541: his system had a primary reference to medicine: he was acute, and beyond his age in Chemical knowledge. But his theories were most extravagant, deserving Bacon's word "*delirare*." He was full of the analogy between the "Macrocosm" of external Nature, and the "Microcosm" of Man. See Hallam, part I. chap. vii. § 17–20.

luti de flamma et aëre dictum est. Quinetiam spiritus emortuus, qui in omni tangibili animato continetur, id perpetuo agit, ut partes crassiores digerat et vertat in spiritum qui deinde exeat; unde fit diminutio ponderis et exsiccatio, ut alibi diximus. Neque etiam respuenda est in *assimilatione* accretio illa, quam vulgo ab alimentatione distinguunt; veluti cum lutum inter lapillos concrescit, et vertitur in materiam lapideam; squamæ circa dentes vertuntur in substantiam non minus duram, quam sunt dentes ipsi, &c. Sumus enim in ea opinione, inesse corporibus omnibus desiderium assimilandi, non minus quam coëundi ad homogenea: verum ligatur ista virtus, sicut et illa; licet non iisdem modis. Sed modos illos, necnon solutionem ab iisdem, omni diligentia inquirere oportet; quia pertinent ad senectutis refocillationem [88]. Postremo videtur notatu dignum, quod in novem illis motibus, de quibus diximus, corpora tantum naturæ suæ conservationem appetere videntur; in hoc decimo autem propagationem [89].

(12.) Sit motus duodecimus, *motus excitationis* [90]; qui motus videtur esse ex genere *assimilationis*, atque eo nomine quandoque a nobis promiscue vocatur. Est enim motus diffusivus, et communicativus, et transitivus, et multiplicativus, sicut et ille; atque effectu (ut plurimum) consentiunt, licet efficiendi modo et subjecto differant. Motus enim *assimilationis* procedit

[88] Bacon was full of the old Alchemist belief about the prolongation of Life. And for himself he was extremely fanciful about Health. He tells us many of his favourite notions as to diet, &c. in the Sylva Sylvarum.

[89] Bacon here speaks as if this were the 10th not the 11th kind of Motus.

[90] The tendency to excite and diffuse a quality, as Heat is diffused, or as the magnet gives to iron its own qualities without itself losing them.

tanquam cum imperio et potestate; jubet enim et cogit assimilatum in assimilantem verti et mutari. At motus *excitationis* procedit tanquam arte et insinuatione, et furtim; et invitat tantum, et disponit excitatum ad naturam excitantis. Etiam motus *assimilationis* multiplicat et transformat corpora et substantias; veluti plus fit flammæ, plus aëris, plus spiritus, plus carnis. At in motu *excitationis*, multiplicantur et transeunt virtutes tantum; et plus fit calidi, plus magnetici, plus putridi. Eminet autem iste motus præcipue in calido et frigido. Neque enim calor diffundit se in calefaciendo per communicationem primi caloris; sed tantum per *excitationem* partium corporis ad motum illum, qui est forma calidi; de quo in *vindemiatione prima de natura calidi* diximus. Itaque longe tardius et difficilius excitatur calor in lapide aut metallo, quam in aëre; ob inhabilitatem et impromptitudinem corporum illorum ad motum illum; ita ut verisimile sit, posse esse interius versus viscera terræ materias, quæ calefieri prorsus respuant; quia ob condensationem majorem spiritu illo destituuntur, a quo motus iste *excitationis* plerumque incipit. Similiter magnes induit ferrum nova partium dispositione, et motu conformi; ipse autem nihil ex virtute perdit. Similiter fermentum panis, et flos cervisiæ [91], et coagulum lactis, et nonnulla ex venenis, excitant et invitant motum in massa farinaria, aut cervisia, aut caseo, aut corpore humano successivum et continuatum; non tam ex vi excitantis, quam prædispositione et facili cessione excitati.

[91] Flos cervisiæ. "Balm" or yeast. Cervisia was a Gallic name for Beer. "Ex iisdem (frugibus) fiunt et potus, zythum in Ægypto, celia et ceria in Hispania, cervisia, et plura genera in Gallia, aliisque provinciis." Plin. 22. 25. 82.

(13.) Sit motus decimus tertius, *motus impressionis*[92]; qui motus est etiam ex genere motus *assimilationis*, estque ex diffusivis motibus subtilissimus. Nobis autem visum est eum in speciem propriam constituere, propter differentiam insignem quam habet, erga priores duos. Motus enim *assimilationis* simplex corpora ipsa transformat; ita ut si tollas primum movens, nihil intersit ad ea quæ sequuntur. Neque enim prima accensio in flammam, aut prima versio in aërem, aliquid facit ad flammam, aut aërem, in generatione succedentem. Similiter, motus *excitationis* omnino manet, remoto primo movente, ad tempora bene diuturna; ut in corpore calefacto, remoto primo calore; in ferro excito, remoto magnete; in massa farinaria, remoto fermento. At motus *impressionis*, licet sit diffusivus, et transitivus, tamen perpetuo pendere videtur ex primo movente; adeo ut, sublato aut cessante illo, statim deficiat et pereat; itaque etiam momento, aut saltem exiguo tempore transigitur. Quare motus illos *assimilationis* et *excitationis*, *motus generationis Jovis*, quia generatio manet; hunc autem motum, *motum generationis Saturni*, quia natus statim devoratur et absorbetur, appellare consuevimus. Manifestat se vero hic motus in tribus; in lucis radiis; sonorum percussionibus; et magneticis, quatenus ad communicationem. Etenim, amota luce, statim pereunt colores, et reliquæ imagines ejus; amota percussione prima, et quassatione corporis inde facta, paulo post perit sonus. Licet enim soni etiam in medio per ventos tanquam per undas agitentur[93]; tamen diligentius notandum est, quod sonus non

[92] The *Motion of Impression* occurs when there seems to be a continual communication of impulses from the body which is the original source of it: as in the case of rays of light.

[93] The propagation of Sound: Bacon seems to have come very

tam diu durat, quam fit resonatio. Etenim impulsa campana, sonus ad bene magnum tempus continuari videtur; unde quis facile in errorem labatur, si existimet toto illo tempore sonum tanquam natare et hærere in aëre; quod falsissimum est. Etenim illa resonatio non est idem sonus numero, sed renovatur. Hoc autem manifestatur ex sedatione sive cohibitione corporis percussi. Si enim sistatur et detineatur campana fortiter, et fiat immobilis, statim perit sonus, nec resonat amplius: ut in chordis; si post primam percussionem tangatur chorda, vel digito, ut in lyra; vel calamo, ut in espinetis; statim desinit resonatio. Magnete autem remoto, statim ferrum decidit. Luna autem a mari non potest removeri; nec terra a ponderoso dum cadit. Itaque de illis nullum fieri potest experimentum; sed ratio eadem est.

(14.) Sit motus decimus quartus, *motus configurationis*, aut *situs*[94]; per quem corpora appetere videntur non coitionem, aut separationem aliquam; sed situm, et collocationem, et *configurationem* cum aliis. Est autem iste motus valde abstrusus, nec bene inquisitus. Atque in quibusdam videtur quasi incausabilis; licet revera (ut existimamus) non ita sit. Etenim si quæratur, cur potius cœlum volvatur ab oriente in occidentem, quam ab occidente in orientem: aut cur vertatur circa polos positos juxta ursas, potius quam circa orionem, aut ex alia aliqua parte cœli? Videtur ista quæ-

near the "undulatory theory of Sound," as he holds that it is passed on from point to point, which he calls "resonatio."

[94] This would apply to the Laws of Structure, by which (for example) Crystals assume always their proper shape; or vegetables follow each their own cellular or fibrous structures. To this class Bacon strangely refers the direction of the celestial motions: and the polarity of the Needle. It seems on the whole to trench upon the province of "Latens Schematismus."

stio tanquam quædam ecstasis; cum ista potius ab experientia, et ut positiva, recipi debeant. At in natura profecto sunt quædam ultima et incausabilia; verum hoc ex illis non esse videtur. Etenim hoc fieri existimamus ex quadam harmonia et consensu mundi, qui adhuc non venit in observationem[95]. Quod si recipiatur motus terræ ab occidente in orientem; eædem manent quæstiones. Nam et ipsa super aliquos polos movetur. Atque, cur tandem debeant isti poli collocari magis ubi sunt, quam alibi? Item verticitas, et directio, et declinatio magnetis ad hunc motum referuntur. Etiam inveniuntur in corporibus tam naturalibus quam artificialibus, præsertim consistentibus, et non fluidis, collocatio quædam et positura partium, et tanquam villi et fibræ, quæ diligenter investigandæ sunt; utpote sine quarum inventione corpora illa commode tractari aut regi non possunt. At circulationes illas in liquidis, per quas illa, dum pressa sint, antequam se liberare possunt, se invicem relevant, ut compressionem illam ex æquo tolerent, motui *libertatis* verius assignamus.

(15.) Sit motus decimus quintus, *motus pertransitionis*, sive *motus secundum meatus*[96]; per quem virtutes corporum magis aut minus impediuntur, aut provehuntur a mediis ipsorum, pro natura corporum et virtutum operantium, atque etiam medii. Aliud enim medium luci convenit, aliud sono, aliud calori et frigori, aliud virtutibus magneticis, nec non aliis nonnullis respective.

(16.) Sit motus decimus sextus, *motus regius* (ita

[95] This has been fulfilled, though not as Bacon thought it would be, by the discovery of the universal Law of Gravitation.

[96] This class refers only to the effect caused by the *medium* through which any agency is carried on; as when heat or light are modified by passing through different substances. Under this head might be placed the discussion on "Motion in Resisting Media" in Dynamics.

enim eum appellamus) sive *politicus*[97]; per quem partes in corpore aliquo prædominantes et imperantes, reliquas partes frænant, domant, subigunt, ordinant, et cogunt eas adunari, separari, consistere, moveri, collocari, non ex desideriis suis, sed prout in ordine sit, et conducat ad bene esse partis illius imperantis; adeo ut sit quasi *regimen* et *politia* quædam, quam exercet pars regens in partes subditas. Eminet autem hic motus præcipue in spiritibus animalium, qui motus omnes partium reliquarum, quamdiu ipse in vigore est, contemperat. Invenitur autem in aliis corporibus in gradu inferiore; quemadmodum dictum est de sanguine et urinis, quæ non solvuntur, donec spiritus, qui partes earum commiscebat et cohibebat, emissus fuerit aut suffocatus. Neque iste motus omnino spiritibus proprius est, licet in plerisque corporibus spiritus dominentur ob motum celerem, et penetrationem. Veruntamen in corporibus magis condensatis, nec spiritu vivido et vigente (qualis inest argento vivo et vitriolo) repletis, dominantur potius partes crassiores, adeo ut nisi frænum et jugum hoc arte aliqua excutiatur, de nova aliqua hujusmodi corporum transformatione minime sperandum sit. Neque vero quispiam nos oblitos esse existimet ejus quod nunc agitur, quia, cum ista series et distributio motuum ad nil aliud spectet, quam ut illorum *prædominantia* per *instantias luctæ* melius inquiratur, jam inter motus ipsos *prædominantiæ* mentionem faciamus. Non enim in descriptione *motus* istius *regii*, de *prædominantia* motuum aut virtutum tractamus, sed de *prædominantia* partium in corporibus. Hæc enim ea est *prædominantia*, quæ speciem istam motus peculiarem constituit.

97 This class is a very obscure one. It refers to that ruling power or property in a substance which controls all the rest.

(17.) Sit motus decimus septimus, *motus rotationis spontaneus*[98]; per quem corpora motu gaudentia, et bene collocata, natura sua fruuntur, atque seipsa sequuntur, non aliud; et tanquam proprios petunt amplexus. Etenim videntur corpora aut movere sine termino; aut plane quiescere; aut ferri ad terminum, ubi pro natura sua aut rotent, aut quiescant. Atque quæ bene collocata sunt, si motu gaudeant, movent per circulum: motu scilicet æterno et infinito. Quæ bene collocata sunt, et motum exhorrent, prorsus quiescunt. Quæ non bene collocata sunt, movent in linea recta (tanquam tramite brevissimo) ad consortia suorum connaturalium. Recipit autem motus iste *rotationis* differentias novem. Primam, centri sui, circa quod corpora movent: secundam, polorum suorum, supra quos movent: tertiam, circumferentiæ sive ambitus sui, prout distant a centro: quartam, incitationis suæ, prout celerius aut tardius rotant: quintam, consequutionis motus sui, veluti ab oriente in occidentem, aut ab occidente in orientem: sextam, declinationis a circulo perfecto per spiras longius aut propius distantes a centro suo: septimam, declinationis a circulo perfecto per spiras longius aut propius distantes a polis suis: octavam, distantiæ propioris aut longioris spirarum suarum ad invicem: nonam et ultimam, variationis ipsorum polorum, si sint mobiles: quæ ipsa ad rotationem non pertinet, nisi fiat circulariter. Atque iste motus communi et inveterata opinione habetur pro proprio cœlestium. Attamen gravis de illo motu lis est inter nonnullos tam ex antiquis quam modernis, qui *rotationem* terræ attribuerunt. At multo fortasse justior movetur controversia, (si modo res non sit omnino extra controver-

[98] Cf. supra, II. 5. ad fin., and II. 36. ex. 2.

siam) an motus videlicet iste (concesso quod terra stet) cœli finibus contineatur, an potius descendat, et communicetur aëri, et aquis. Motum autem *rotationis* in missilibus, ut in spiculis, sagittis, pilis sclopetorum, et similibus, omnino ad motum *libertatis* rejicimus.

(18.) Sit motus decimus octavus, *motus trepidationis*, cui (ut ab astronomis intelligitur) non multum fidei adhibemus[99]. Nobis autem, corporum naturalium appetitus ubique serio perscrutantibus, occurrit iste motus; et constitui debere videtur in speciem. Est autem hic motus veluti æternæ cujusdam captivitatis. Videlicet ubi corpora non omnino pro natura sua bene locata, et tamen non prorsus male se habentia, perpetuo trepidant, et irrequiete se agunt, nec statu suo contenta, nec ulterius ausa progredi. Talis invenitur motus in corde et pulsibus animalium; et necesse est ut sit in omnibus corporibus, quæ statu ancipiti ita degunt inter commoda et incommoda, ut distracta liberare se tentent, et denuo repulsam patiantur, et tamen perpetuo experiantur.

(19.) Sit motus decimus nonus et postremus, motus ille cui vix nomen motus competit, et tamen est plane motus. Quem motum, *motum decubitus*, sive *motum exhorrentiæ motus*, vocare licet[100]. Per hunc motum terra stat mole sua, moventibus se extremis suis in medium; non ad centrum imaginativum, sed ad unionem[1].—Per hunc etiam appetitum omnia majorem in modum condensata motum exhorrent; atque illis pro omni appetitu est non moveri; et licet infinitis modis vellicentur et provocentur ad motum, tamen naturam

[99] To this class Bacon does not give much credit. It seems, however, that pulsation may be referred to it as a distinct kind of Motion.

[100] This passage, from the repetitions of the word *motus*, is a fair specimen of Bacon's carelessness in style. It is a strange kind of Motion, being, in fact, *inertia*.

[1] Cf. supra, II. 35.

suam (quoad possunt) tuentur. Quod si ad motum compellantur, tamen hoc agere semper videntur, ut quietem et statum suum recuperent, neque amplius moveant. Atque circa hoc certe se agilia præbent, et satis perniciter et rapide (ut pertæsa et impatientia omnis moræ) contendunt. Hujus autem appetitus imago ex parte tantum cerni potest; quia hic apud nos, ex subactione et concoctione cœlestium, omne tangibile non tantum non condensatum est ad ultimitatem, sed etiam cum spiritu nonnullo miscetur.

Proposuimus itaque jam species, sive elementa simplicia motuum, appetituum, et virtutum activarum, quæ sunt in natura maxime catholica. Neque parum scientiæ naturalis sub illis adumbratum est. Non negamus tamen, et alias species fortasse addi posse; atque istas ipsas divisiones secundum veriores rerum venas transferri; denique in minorem numerum posse redigi. Neque tamen hoc de divisionibus aliquibus abstractis intelligimus: veluti si quis dicat, corpora appetere vel conservationem, vel exaltationem, vel propagationem, vel fruitionem naturæ suæ: aut si quis dicat, motus rerum tendere ad conservationem et bonum, vel universi, ut *antitypiam* et *nexum;* vel universitatum magnarum, ut motus *congregationis majoris, rotationis*, et *exhorrentiæ motus;* vel formarum specialium, ut reliquos. Licet enim hæc vera sint, tamen nisi terminentur in materia et fabrica secundum veras lineas, speculativa sunt, et minus utilia. Interim sufficient, et boni erunt usus, ad pensitandas *prædominantias* virtutum, et exquirendas *instantias luctæ;* id quod nunc agitur.

Etenim ex his quos proposuimus motibus, alii prorsus sunt invincibiles; alii aliis sunt fortiores, et illos ligant, frænant, disponunt; alii aliis longius jaculantur;

alii alios tempore et celeritate prævertunt; alii alios fovent, roborant, ampliant, accelerant.

Motus *antitypiæ* omnino est adamantinus et invincibilis. Utrum vero motus *nexus* sit invincibilis, adhuc hæremus. Neque enim pro certo affirmaverimus, utrum detur vacuum, sive coacervatum, sive permistum[2]. At de illo nobis constat, rationem illam, propter quam introductum est vacuum a Leucippo, et Democrito[3], (videlicet quod absque eo non possent eadem corpora complecti et implere majora et minora spatia) falsam esse. Est enim plane *plica materiæ*, complicantis et replicantis se per spatia inter certos fines absque interpositione vacui: neque est in aëre, ex vacuo, bis millies (tantum enim esse oportet) plus quam in auro. Id quod ex potentissimis corporum pneumaticorum virtutibus, (quæ aliter tanquam pulveres minuti natarent in vacuo) et multis aliis demonstrationibus, nobis satis liquet. Reliqui vero motus regunt et reguntur invicem, pro rationibus vigoris, quanti, incitationis, ejaculationis, necnon tum auxiliorum, tum impedimentorum, quæ occurrunt.

Exempli gratia; magnes armatus nonnullus detinet et suspendit ferrum ad sexagecuplum pondus ipsius; eo usque dominatur motus *congregationis minoris*, super motum *congregationis majoris;* quod si majus fuerit pondus, succumbit. Vectis tanti roboris sublevabit tantum pondus; eo usque dominatur motus *libertatis* super motum *congregationis majoris;* sin majus fuerit

[2] Bacon here seems to have suspected that the ordinary notion of a Vacuum was unfounded. But what does he mean by "Vacuum sive coacervatum sive permistum?" Below, II. 50, he speaks of "Aer permistus" and "aer coacervatus et circumfusus," meaning, by the former, air mingled with powdered substances, and by the latter, air in bulk as it lies around and upon such substances. I have ventured to translate it "Vacuum, either entire or partial."

[3] See supra, I. 51.

pondus, succumbit. Corium tensum ad tensuram talem non rumpitur; eo usque dominatur motus *continuationis* super motum *tensuræ;* quod si ulterior fuerit tensura, rumpitur corium, et succumbit motus *continuationis*. Aqua per rimam perforationis talis effluit; eo usque dominatur motus *congregationis majoris* super motum *continuationis;* quod si minor fuerit rima, succumbit; et vincit motus *continuationis*. In pulvere sulphuris solius immissi in sclopetum cum pila, et admoto igne, non emittitur pila; in eo motus *congregationis majoris* vincit motum *hyles*. At in pulvere pyrio immisso vincit motus *hyles* in sulphure; adjutus motibus *hyles* et *fugæ* in nitro. Et sic de cæteris. Etenim *instantiæ luctæ* (quæ indicant *prædominantiam* virtutum, et secundum quas rationes et calculos prædominentur et succumbant) acri et sedula diligentia undique sunt conquirendæ.

Etiam modi et rationes ipsius succumbentiæ motuum diligenter sunt introspiciendæ. Nempe, an omnino cessent, vel potius usque nitantur, sed ligentur. Etenim in corporibus hic apud nos nulla vera est quies, nec in integris, nec in partibus; sed tantum secundum apparentiam. Quies autem ista apparens, causatur aut per *æquilibrium;* aut per absolutam *prædominantiam* motuum. Per *æquilibrium*, ut in bilancibus, quæ stant, si æqua sint pondera. Per *prædominantiam*, ut in hydriis perforatis, ubi quiescit aqua, et detinetur a decasu per *prædominantiam* motus *nexus*[4]. Notandum tamen est (ut diximus) quatenus nitantur motus illi succumbentes. Etenim si quis per luctam detineatur extensus in terra, brachiis et tibiis vinctis, aut aliter detentis; atque ille tamen totis viribus re-

[4] Here again Bacon was in want of the knowledge of the pressure of the Atmosphere.

surgere nitatur; non est minor nixus, licet non proficiat. Hujus autem rei conditio, (scilicet utrum per *prædominantiam* motus succumbens quasi annihiletur; an potius continuetur nixus, licet non conspiciatur) quæ latet in conflictibus, apparebit fortasse in concurrentiis. Exempli gratia; fiat experimentum in sclopetis, utrum sclopetus, pro tanto spatio, quo emittat pilam in linea directa, sive (ut vulgo loquuntur) in puncto blanco, debiliorem edat percussionem ejaculando in supra, ubi motus ictus est simplex, quam desuper, ubi motus gravitatis concurrit cum ictu.

Etiam canones *prædominantiarum*, qui occurrunt, colligendi sunt. Veluti, quod quo communius est bonum quod appetitur, eo motus est fortior: ut motus nexus, qui respicit communionem universi, fortior est motu gravitatis, qui respicit communionem densorum. Etiam, quod appetitus, qui sunt boni privati, non prævalent plerunque contra appetitus boni magis publici; nisi in parvis quantis. Quæ utinam obtinerent in civilibus[5].

XLIX.

Inter *prærogativas instantiarum* ponemus loco vicesimo quinto *instantias innuentes*[6]; eas scilicet, quæ

[5] A good specimen of Bacon's attachment to Analogies.

He seemed inclined himself to rank this Chapter very highly: but it is in fact one of his worst specimens, being full of Idola. There are fanciful and unnecessary subdivisions, not helped by fanciful Nomenclature: and Motus is used for "Appetition," "Gravity," "Sympathy," "Resistance," and "Inertia."

[6] We are now come to the three Instantiæ Benevolæ or Propitiæ—Instances facilitating Practice. Of these the first intimate or direct—tend to free practice from useless pursuits, and guide it to things beneficial to man. This is a most valuable Aphorism. It shews that with all Bacon's love for knowledge, he saw that of itself it could not give happiness. "Amplificant, non beant." The mind is affected by it, and not the Heart. But a just application of knowledge, a judicious selection of Instances for Practice, will really do much towards promoting happiness, by easing and bettering the general con-

commoda hominum innuunt aut designant. Etenim ipsum *posse* et ipsum *scire*, naturam humanam amplificant, non beant. Itaque decerpenda sunt ex universitate rerum ea quæ ad usus vitæ maxime faciunt. Verum de iis erit magis proprius dicendi locus, cum *deductiones ad praxim* tractabimus. Quinetiam in ipso opere *interpretationis* circa singula subjecta, locum semper *chartæ humanæ*, sive *chartæ optativæ* assignamus. Etenim et quærere et optare non inepte, pars scientiæ est.

L.

Inter *prærogativas instantiarum* ponemus loco vicesimo sexto *instantias polychrestas*[7]. Eæ sunt, quæ pertinent ad varia, et sæpius occurrunt; ideoque operæ et novis probationibus haud parum parcunt. Atque de instrumentis ipsis atque ingeniationibus[8] proprius erit dicendi locus, cum *deductiones ad praxim* et experimentandi modos tractabimus. Quin etiam quæ adhuc cognita sunt, et in usum venerunt, in historiis particularibus singularum artium describentur. In præsenti autem subjungemus quædam catholica circa ea pro exemplis tantum *polychresti*.

Operatur igitur homo super corpora naturalia (præter ipsam admotionem et amotionem corporum simplicem) septem præcipue modis: nempe, vel per exclu-

dition of life. The maxim at the end of the Aphorism, "quærere et optare, &c." is but another form of the famous "Prudens quæstio est dimidium scientiæ." Not undiscerning collection, but wise selection, is the great principle. In a ponderous way the whole of the "Prerogatives" are supposed to lead towards this end.

7 "Instantiæ polychrestas," πολυχρησταὶ, things generally useful, and applicable to a great variety of investigations, by shortening and facilitating the process. This Class can only be partially investigated here: for it includes in fact almost every thing connected with Physical discovery.

8 Ingeniationes. This word is not Latin. Ingeniatus is.

sionem eorum quæ impediunt et disturbant: vel per compressiones, extensiones, agitationes, et hujusmodi: vel per calorem et frigus: vel per moram in loco convenienti: vel per frænum et regimen motus: vel per consensus speciales: vel per alternationem tempestivam et debitam: atque seriem et successionem horum omnium, aut saltem nonnullorum ex illis.

(1.) Ad primum igitur quod attinet; aër communis, qui undique præsto est et se ingerit, atque radii cœlestium, multum turbant. Quæ itaque ad illorum exclusionem faciunt, merito haberi possint pro *polychrestis*. Huc igitur pertinent materies et crassities vasorum, in quibus corpora ad operationem præparata reponuntur. Similiter modi accurati obturationis vasorum, per consolidationem, et *lutum sapientiæ*[9], ut loquuntur chemici. Etiam clausura per liquores in extimis utilissima res est: ut cum infundunt oleum super vinum aut succos herbarum; quod expandendo se in summitate instar operculi, optime ea conservat illæsa ab aëre. Neque pulveres res malæ sunt; qui licet contineant aërem permistum, tamen vim aëris coacervati et circumfusi arcent[10]; ut fit in conservatione uvarum et fructuum intra arenam, et farinam. Etiam cera, mel, pix, et hujusmodi tenacia, recte obducuntur ad clausuram perfectiorem, et ad summovendum aërem et cœlestia. Etiam nos experimentum quandoque fecimus, ponendo vas, necnon aliqua alia corpora, intra argentum vivum, quod omnium longe densissimum est ex iis quæ circumfundi possunt. Quinetiam specus et cavernæ subterraneæ magni usus sunt ad prohibendum insolationem et aërem istum apertum prædatorium;

[9] *Lutum sapientiæ*, a composition used to seal the orifices of vessels hermetically.

[10] Cf. supr. II. 48. (note 3.)

qualibus utuntur Germani septentrionales pro granariis. Nec non repositio corporum in fundo aquarum ad hoc spectat: ut memini me quippiam audisse de utribus vini demissis in profundum puteum, ad infrigidationem scilicet; sed casu et per neglectum ac oblivionem ibidem remanentibus per multos annos, et deinde extractis; unde vinum factum est non solum non vapidum, aut emortuum, sed multo magis nobile ad gustum; per commixtionem partium suarum (ut videtur) magis exquisitam. Quod si postulet res, ut corpora demittantur ad fundum aquarum, veluti intra fluvios aut mare, neque tamen aquas tangant, nec in vasibus obturatis concludantur, sed aëre tantum circundentur; bonus est usus vasis illius, quod adhibitum est nonnunquam ad operandum subter aquis super navigia demersa, ut urinatores diutius manere possint sub aquis, et per vices ad tempus respirare. Illud hujusmodi erat. Conficiebatur dolium ex metallo concavum, quod demittebatur æquabiliter ad superficiem aquæ, atque sic deportabat totum aërem, qui continebatur in dolio, secum in fundum maris. Stabat autem super pedes tres, (instar tripodis) qui longitudinis erant aliquanto minoris statura hominis; ita ut urinator posset, cum anhelitus deficeret, immittere caput in cavum dolii, et respirare, et deinde opus continuare. Atque audivimus, inventam esse jam machinam aliquam naviculæ aut scaphæ, quæ homines subter aquis vehere possit ad spatia nonnulla[11]. Verum sub tali vase, quale modo diximus, corpora quævis facile suspendi possint; cujus causa hoc experimentum adduximus.

Est et alius usus diligentis et perfectæ clausuræ cor-

[11] These under-water boats appear again in the New Atlantis. "We have ships and boats for going under water, and brooking of seas."

porum: nempe, non solum ut prohibeatur aditus aëris per exterius, (de quo jam dictum est) verum etiam ut cohibeatur exitus spiritus corporis, super quod fit operatio per interius. Necesse est enim ut operanti circa corpora naturalia constet de summis suis: viz. quod nihil expirarit aut effluxerit. Fiunt enim profundæ alterationes in corporibus, quando, natura prohibente annihilationem, ars prohibeat etiam deperditionem aut evolationem alicujus partis. Atque hac de re invaluit opinio falsa; (quæ si vera esset, de ista conservatione summæ certæ absque diminutione esset fere desperandum) viz. spiritus corporum, et aërem majori gradu caloris attenuatum, nullis vasorum claustris posse contineri, quin per poros vasorum subtiliores evolent. Atque in hanc opinionem adducti sunt homines per vulgata illa experimenta, poculi inversi super aquam cum candela aut charta inflammata, ex quo fit ut aqua sursum attrahatur; atque similiter ventosarum, quæ super flammam calefactæ trahunt carnes. Existimant enim, in utroque experimento aërem attenuatum emitti, et inde *quantum* ipsius minui; ideoque aquam aut carnes per *nexum* succedere[12]. Quod falsissimum est. Aër enim non *quanto* diminuitur, sed spatio contrahitur; neque incipit motus iste successionis aquæ, antequam fiat extinctio flammæ, aut refrigeratio aëris: adeo ut medici, quo fortius attrahant ventosæ, ponant spongias frigidas aqua madefactas seper ventosas. Itaque non est cur homines multum sibi metuant de facili exitu aëris, aut spirituum. Licet enim verum sit, etiam solidissima corpora habere suos poros, tamen ægre

[12] Bacon's account is erroneous. Air when heated expands, and so some of it escapes: then if the orifice of the Vessel be placed on Water or Flesh, and the entrance of air be so closed, as the air cools it will contract, and the pressure of the external atmosphere drives the water or flesh upwards into the vessel.

patitur aër aut spiritus comminutionem sui ad tantam subtilitatem; quemadmodum et aqua exire recusat per rimam minusculam.

(2.) De secundo vero modo ex septem prædictis illud inprimis notandum est, valere certe compressiones et hujusmodi violentias ad motum localem, atque alia id genus, potentissime; ut in machinis et missilibus: etiam ad destructionem corporis organici, atque earum virtutum, quæ consistunt plane in motu. Omnis enim vita, immo etiam omnis flamma et ignitio, destruitur per compressiones; ut et omnis machina corrumpitur et confunditur per easdem. Etiam ad destructionem virtutum, quæ consistunt in posituris, et dissimilaritate partium paulo crassiore; ut in coloribus (neque enim idem color floris integri et contusi, neque succini integri et pulverizati). Etiam in saporibus (neque enim idem sapor pyri immaturi, et ejusdem compressi ac subacti; nam manifesto dulcedinem majorem concipit). Verum ad transformationes et alterationes nobiliores corporum similarium non multum valent istæ violentiæ; quia corpora per eas non acquirunt consistentiam aliquam novam constantem et quiescentem, sed transitoriam et nitentem semper ad restitutionem et liberationem sui. Attamen non abs re foret, hujus rei facere experimenta aliqua diligentiora; ad hoc scilicet, utrum condensatio corporis bene similaris, (qualia sunt aër, aqua, oleum, et hujusmodi) aut rarefactio, similiter per violentiam indita, possint fieri constantes et fixæ, et quasi mutatæ in naturam. Id quod primo experiendum per moram simplicem; deinde per auxilia et consensus. Atque illud nobis in promptu fuisset, (si modo in mentem venisset) cum aquam (de qua alibi[13]) per malleati-

[13] "de qua alibi:" sc. supra II. 45. ad finem.

ones et pressoria condensavimus, antequam erumperet. Debueramus enim sphæram complanatam per aliquot dies sibi permisisse, et tum demum aquam extraxisse; ut fieret experimentum, utrum statim impletura fuisset talem dimensionem, qualem habebat ante condensationem. Quod si non fecisset aut statim, aut certe paulo post; constans videlicet facta videri potuisset ista condensatio: sin minus, apparuisset, factam fuisse restitutionem, et compressionem fuisse transitoriam. Etiam simile quiddam faciendum erat circa extensionem aëris in ovis vitreis. Etenim debuerat fieri, post exsuctionem fortem, subita et firma obturatio; deinde debuerant ova illa manere ita obturata per nonnullos dies; et tum demum experiendum fuisset, utrum aperto foramine attractus fuisset aër cum sibilo, aut etiam attracta fuisset tanta quantitas aquæ post immersionem, quanta fuisset ab initio, si nulla adhibita fuisset mora. Probabile enim aut saltem dignum probatione est, hæc fieri potuisse et posse; propterea quod in corporibus paulo magis dissimilaribus similia efficiat mora temporis. Etenim baculum per compressionem curvatum post aliquod tempus non resilit: neque id imputandum est alicui deperditioni ex quanto ligni per moram; nam idem fiet in lamina ferri, (si augeatur mora) quæ non est expirabilis. Quod si non succedat experimentum per moram simplicem; tamen non deserendum est negotium, sed auxilia alia adhibenda. Non enim parum lucri fit, si per violentias indi possint corporibus naturæ fixæ et constantes. Hac enim ratione aër possit verti in aquam per condensationes[14]; et complura alia id genus. Do-

[14] "M. Biot first proved this supposition to be well-founded, and succeeded in forming Water from Hydrogen and Oxygen by compression only." Account of the Nov. Org. part 2. p. 31. (Library of Useful Knowledge.) Cf. Herschel's Discourse, § 358.

minus enim est homo motuum violentorum, magis quam cæterorum.

(3.) At tertius ex septem modis refertur ad magnum illud organum tam naturæ quam artis, quoad operandum; videlicet calidum et frigidum. Atque in hac parte claudicat plane potentia humana, tanquam ex uno pede. Habemus enim calorem ignis, qui caloribus solis (prout ad nos deferuntur) et caloribus animalium, quasi infinitis partibus, potentior est et intensior. At deest frigus, nisi quale per tempestates hyemales, aut per cavernas, aut per circumdationes nivis et glaciei, haberi potest: quod in comparatione æquari potest cum calore fortasse solis meridiano, in regione aliqua ex torridis, aucto insuper per reverberationes montium et parietum: nam hujusmodi, utique tam calores quam frigora, ab animalibus ad tempus exiguum tolerari possunt. Nihili autem sunt fere præ calore fornacis ardentis, aut alicujus frigoris quod huic gradui respondeat[15]. Itaque omnia hic apud nos vergunt ad rarefactionem, et desiccationem, et consumptionem: nihil fere ad condensationem, et inteneratiouem, nisi per misturas et modos quasi spurios. Quare instantiæ frigoris omni diligentia sunt conquirendæ: quales videntur inveniri in expositione corporum super turres quando gelat acriter: in cavernis subterraneis: circumdationibus nivis et glaciei, in locis profundioribus, et ad hoc excavatis: demissione corporum in puteos: sepulturis corporum in argento vivo et metallis: immersione corporum in aquis, quæ vertunt ligna in lapides: defossione corporum in terra; (qualis fertur apud Chinenses esse confectio porcellanæ[16], ubi massæ ad hoc factæ dicuntur

[15] See supr. II. 20. (note 36.)

[16] Porcelain. The word itself bears testimony to the belief that the prepared earths were buried for a long time, as it is derived probably from a quasi-Latin word *pro-*

manere intra terram per quadraginta aut quinquaginta annos, et transmitti ad hæredes, tanquam mineræ quædam artificiales) et hujusmodi. Quinetiam quæ interveniunt in natura condensationes, factæ per frigora, similiter sunt investigandæ; ut causis eorum cognitis, transferri possint in artes. Quales cernuntur in exsudatione marmoris et lapidum: in rorationibus super vitra per interius fenestrarum sub auroram, post gelu noctis: in originibus et collectionibus vaporum in aquas sub terra, unde sæpe scaturiunt fontes: et quæcunque sunt hujus generis.

Inveniuntur autem, præter illa quæ sunt frigida ad tactum, quædam alia potestate frigida, quæ etiam condensant; veruntamen operari videntur super corpora animalium tantum, et vix ultra. Hujus generis se ostendunt multa in medicinis et emplastris. Alia autem condensant carnes et partes tangibiles; qualia sunt medicamenta astringentia, atque etiam inspissantia: alia condensant spiritus, id quod maxime cernitur in soporiferis. Duplex autem est modus condensationis spirituum per medicamenta soporifera, sive provocantia somnum: alter per sedationem motus; alter per fugam spirituum. Etenim viola, rosa sicca, lactuca, et hujusmodi benedicta sive benigna, per vapores suos amicos et moderate refrigerantes, invitant spiritus ut se uniant, et ipsorum acrem et inquietum motum compescunt. Etiam aqua rosacea, apposita ad nares in deliquiis animæ, spiritus resolutos et nimium relaxatos se recipere facit, et tanquam alit. At opiata, et eorum affinia, spiritus plane fugant, ex qualitate sua maligna et inimica. Itaque si applicentur parti exteriori, statim aufugiunt spiritus ab illa parte, nec amplius libenter

cellanea, earth kept in *cells*. The Chinese do not so bury their masses of earth. See Richardson's Dict. verbo.

influunt: sin sumantur interius, vapores eorum, ascendentes ad caput, spiritus in ventriculis cerebri contentos undequaque fugant: cumque se retrahant spiritus, neque in aliam partem effugere possint, per consequens coëunt, et condensantur; et quandoque plane exstinguuntur et suffocantur[17]. Licet rursus eadem opiata moderate sumpta, per accidens secundarium, (videlicet condensationem illam quæ a coitione succedit) confortent spiritus, eosque reddant magis robustos, et retundant eorum inutiles et incensivos motus: ex quo ad curas morborum et vitæ prolongationem haud parum conferant.

Etiam præparationes corporum ad excipiendum frigus non sunt omittendæ; veluti quod aqua parum tepida facilius conglacietur, quam omnino frigida, et hujusmodi.

Præterea, quia natura frigus tam parce suppeditat, faciendum est quemadmodum pharmacopolæ solent; qui, quando simplex aliquod haberi non possit, capiunt succedaneum ejus, et *quid* pro *quo*, ut vocant: veluti lignum aloes pro xylobalsamo, cassiam pro cinnamomo. Simili modo diligenter circumspiciendum est, si quæ sint succedanea frigoris; videlicet, quibus modis fieri possint condensationes in corporibus aliter quam per frigus, quod illas efficit, ut opus suum proprium. Illæ autem condensationes videntur intra quaternum numerum (quantum adhuc liquet) contineri. Quarum prima videtur fieri per contrusionem simplicem: quæ parum potest ad densitatem constantem, (resiliunt enim corpora) sed nihilominus forte res auxiliaris esse queat.

[17] This description of the effects of Opiates is extremely quaint and arbitrary; one might almost fancy it one of the "delirationes Paracelsi" of which Bacon speaks with such contempt. For his views on "Spirit," see supra, II. 27. 40, and I. 50. (note 64.)

Secunda fit per contractionem partium crassiorum in corpore aliquo post evolationem aut exitum partium tenuiorum, ut fit in indurationibus per ignem, et repetitis exstinctionibus metallorum, et similibus. Tertia fit per coitionem partium homogenearum, quæ sunt maxime solidæ in corpore aliquo, atque antea fuerant distractæ, et cum minus solidis commistæ: veluti in restitutione mercurii sublimati, qui in pulvere longe majus occupat spatium, quam mercurius simplex; et similiter in omni repurgatione metallorum a scoriis suis. Quarta fit per consensus, admovendo quæ ex vi corporum occulta condensant: qui consensus adhuc raro se ostendunt: quod mirum minime est, quoniam antequam inventio succedat formarum et schematismorum, de inquisitione consensuum non multum sperandum est. Certe quoad corpora animalium, dubium non est, quin sint complures medicinæ, tam interius quam exterius sumptæ, quæ condensant, tanquam per consensum, ut paulo ante diximus. Sed in inanimatis rara est hujusmodi operatio. Percrebuit sane, tam scriptis quam fama, narratio de arbore in una ex insulis sive Terceris[18] sive Canariis, (neque enim bene memini,) quæ perpetuo stillat; adeo ut inhabitantibus nonnullam commoditatem aquæ præbeat. Paracelsus autem ait, herbam vocatam *rorem solis*[19] meridie et fervente sole rore impleri, cum aliæ herbæ undique sint siccæ. At nos utramque narrationem fabulosam esse existimamus. Omnino autem illæ instantiæ nobilissimi forent usus, et introspectione dignissimæ, si essent veræ. Etiam rores illos mellitos, et instar mannæ, qui super foliis quercus inveniuntur mense Maio, non existimamus fieri et densari a consensu aliquo, sive

[18] The Tercery Islands, now called the Azores.
[19] *Ros solis*—"Sundew."

a proprietate folii quercus[20]; sed cum super aliis foliis pariter cadant, contineri scilicet et durare in foliis quercus, quia sunt bene unita, nec spongiosa, ut plurima ex aliis.

Calorem vero quod attinet; copia et potestas nimirum homini abunde adest; observatio autem et inquisitio deficit in nonnullis, iisque maxime necessariis; utcunque spagirici[21] se venditent. Etenim caloris intensioris opificia exquiruntur et conspiciuntur; remissioris vero, quæ maxime in vias naturæ incidunt, non tentantur, adeoque latent. Itaque videmus per vulcanos istos, qui in pretio sunt, spiritus corporum magnopere exaltari, ut in aquis fortibus, et nonnullis aliis oleis chemicis, partes tangibiles indurari, et, emisso volatili, aliquando figi; partes homogeneas separari; etiam corpora heterogenea grosso modo incorporari et commisceri; maxime autem compages corporum compositorum et subtiliores schematismos destrui et confundi. Debuerant autem opificia caloris lenioris tentari et exquiri; unde subtiliores misturæ et schematismi ordinati gigni possint et educi, ad exemplum naturæ, et imitationem operum solis; quemadmodum in aphorismo de instantiis *fœderis*[22] quædam adumbravimus. Opificia enim naturæ transiguntur per longe minores portiones, et posituras magis exquisitas et varias, quam opificia ignis, prout nunc adhibetur. Tum vero videatur homo revera auctus potestate, si per calores et potentias artificiales opera naturæ possint specie repræsentari, virtute perfici, copia variari: quibus addere oportet accelerationem temporis. Nam rubigo ferri

[20] The Honeydew is found on Limes and other trees, as well as on Oaks.

[21] *Spagirici*. Those Alchemists in particular who employed themselves on metals, and the discovery of the Philosopher's stone.

[22] Supra, II. 35.

longo tempore procedit, at versio in crocum martis[23] subito: et similiter de ærugine et cerussa[24]. Crystallum longo tempore conficitur, vitrum subito conflatur. Lapides longo tempore concrescunt, lateres subito coquuntur, &c. Interim (quod nunc agitur) omnes diversitates caloris cum affectibus suis respective diligenter et industrie undique sunt colligendæ et exquirendæ: cœlestium, per radios suos directos, reflexos, refractos, et unitos in speculis comburentibus: fulguris, flammæ, ignis carbonum; ignis ex diversis materiis; ignis aperti, conclusi, angustati, et inundantis, denique per diversas fabricas fornacium qualificati; ignis flatu exciti, quieti et non exciti; ignis ad majorem aut minorem distantiam remoti; ignis per varia media permeantis; calorum humidorum, ut balnei Mariæ[25], fimi, caloris animalium per exterius, caloris animalium per interius, fœni conclusi; calorum aridorum, cineris, calcis, arenæ tepidæ; denique calorum cujusvis generis cum gradibus eorum.

Præcipue vero tentanda est inquisitio et inventio effectuum et opificiorum caloris accedentis et recedentis graduatim, et ordinatim, et periodice, et per debita spatia, et moras. Ista enim inæqualitas ordinata revera filia cœli est, et generationis mater: neque a calore aut vehementi, aut præcipiti, aut subsultorio, aliquid magni expectandum est. Etenim et in vegetabilibus hoc manifestissimum est. Atque etiam in uteris animalium magna est caloris inæqualitas, ex motu, somno, alimentationibus et passionibus fœmellarum quæ uterum ge-

[23] *Crocus Martis*, or Colcothar, the substance which remains after the calcination of Vitriol.

[24] *Cerussa*. Whitelead, made by exposing common lead to the vapour of warm vinegar.

[25] *Balnei Mariæ*. In distillation, when the distilling vessel is placed in a pot filled with water, instead of sand, the operation is said to be performed in a water-bath, or *Balneum Mariæ*.

stant. Denique in ipsis matricibus terræ, iis nimirum, in quibus metalla et fossilia efformantur, locum habet et viget ista inæqualitas. Quo magis notanda est inscitia aliquorum alchemistarum ex reformatis, qui per calores æquabiles lampadum, et hujusmodi, perpetuo uno tenore ardentium, se voti compotes fore existimarunt. Atque de opificiis et effectibus caloris hæc dicta sint. Neque vero tempestivum est illa penitus scrutari, antequam rerum formæ et corporum schematismi ulterius investigati fuerint, et in lucem prodierint. Tum enim quærenda et adoperanda et aptanda sunt instrumenta, quando de exemplaribus constiterit.

(4.) Quartus modus operandi est per moram, quæ certe et promus et condus naturæ est, et quædam dispensatrix. Moram appellamus, cum corpus aliquod sibi permittitur ad tempus notabile, munitum interim et defensum ab aliqua vi externa. Tum enim motus intestini se produnt et perficiunt, cum motus extranei et adventitii cessant. Opera autem ætatis sunt longe subtiliora quam ignis. Neque enim possit fieri talis clarificatio vini per ignem, qualis fit per moram; neque etiam incinerationes per ignem tam sunt exquisitæ quam resolutiones et consumptiones per sæcula. Incorporationes etiam et mistiones subitæ et præcipitatæ per ignem longe inferiores sunt illis, quæ fiunt per moram. At dissimilares et varii schematismi, quos corpora per moras tentant, (quales sunt putredines) per ignem aut calorem vehementiorem destruuntur. Illud interim non abs re fuerit notare; motus corporum penitus conclusorum habere nonnihil ex violento. Incarceratio enim illa impedit motus spontaneos corporis. Itaque mora in vase aperto plus facit ad separationes; in vase penitus clauso ad commistiones; in vase nonnihil clauso, sed subintrante aëre, ad putrefactiones.

Utcunque de opificiis et effectibus moræ undique sunt diligenter conquirendæ instantiæ.

(5.) At regimen motus (quod est quintus ex modis operandi) non parum valet. Regimen autem motus vocamus, cum corpus aliud occurrens, corporis alterius motum spontaneum impedit, repellit, admittit, dirigit. Hoc vero plerunque in figuris et situ vasorum consistit. Etenim conus erectus juvat ad condensationem vaporum in alembicis; at conus inversus juvat ad defæcationem sacchari in vasis resupinatis. Aliquando autem sinuatio requiritur, et angustatio, et dilatatio per vices, et hujusmodi. Etiam omnis percolatio huc spectat; scilicet cum corpus occurrens uni parti corporis alterius viam aperit, alteri obstruit. Neque semper percolatio aut aliud regimen motus fit per extra; sed etiam per corpus in corpore: ut cum lapilli immittuntur in aquas ad colligendam limositatem ipsarum; syrupi clarificantur cum albuminibus ovorum, ut crassiores partes adhærescant, et postea separari possint. Etiam huic regimini motus satis leviter et inscite attribuit Telesius[26] figuras animalium, ob rivulos scilicet et loculos matricis. Debuerat autem notare similem efformationem in testis ovorum, ubi non sunt rugæ aut inæqualitas. At verum est regimen motus efformationes perficere in modulis et proplasticis.

(6.) Operationes vero per consensus aut fugas (qui sextus modus est) latent sæpenumero in profundo. Istæ enim (quas vocant) proprietates occultæ, et specificæ, et sympathiæ et antipathiæ, sunt magna ex parte corruptelæ philosophiæ[27]. Neque de consensibus re-

[26] Telesio. Cf. supr. I. 116.

[27] How far was Bacon himself free from these influences? as when he speaks of the "crude Spirit in Nitre," and its action: or in some of his kinds of Motus in Aph. 48?

rum inveniendis multum sperandum est ante inventionem formarum et schematismorum simplicium. Consensus enim nil aliud est quam symmetria formarum et schematismorum ad invicem.

(*a*.) Atqui majores et magis catholici rerum consensus non prorsus obscuri sunt. Itaque ab iis ordiendum. Eorum prima et summa diversitas ea est; ut quædam corpora copia et raritate materiæ admodum discrepent, schematismis consentiant; alia contra, copia et raritate materiæ consentiant, schematismis discrepent. Nam non male notatum est a chemicis in principiorum suorum triade[28], sulphur et mercurium quasi per universitatem rerum permeare. (Nam de sale inepta ratio est, sed introducta, ut possit comprehendere corpora terrea, sicca, et fixa.) At certe in illis duobus videtur consensus quidam naturæ ex maxime catholicis conspici. Etenim consentiunt sulphur; oleum, et exhalatio pinguis; flamma; et fortasse corpus stellæ. Ex altera parte consentiunt mercurius; aqua, et vapores aquei; aër; et fortasse æther purus et interstellaris. Attamen isti quaterniones gemini[29], sive magnæ rerum tribus, (utraque intra ordines suos) copia materiæ atque densitate immensum differunt, sed schematismo valde conveniunt: ut in plurimis se produnt. At contra metalla diversa copia et densitate multum conveniunt, (præsersertim respectu vegetabilium, &c.) sed schematismo

[28] The *triad* of the Chemists; viz. Sulphur, Mercury, and Salt; which they believed were to be found universally in Nature. The fact that things the same in quantity and proportion of their compounds differ in Structure is well known in chemistry, as may be seen by the example of water and corresponding relative quantities of Hydrogen and Oxygen, which when mixed together continue in a gaseous state, unless they be set fire to.

[29] "Quaterniones gemini," viz.

(I.) (1) Sulphur, with (2) Oil, (3) Flame, (4) The Stars.

(II.) (1) Mercury, with (2) Water, (3) Air, (4) Æther.

multifariam differunt; et similiter vegetabilia et animalia diversa schematismis quasi infinitis variantur; sed intra copiam materiæ, sive densitatem paucorum graduum, continentur.

(β.) Sequitur consensus maxime post priorem catholicus, videlicet corporum principalium et fomitum suorum; videlicet menstruorum, et alimentorum. Itaque exquirendum, sub quibus climatibus, et in qua tellure, et ad quam profunditatem metalla singula generentur; et similiter de gemmis, sive ex rupibus, sive inter mineras natis: in qua gleba terræ, arbores singulæ, et frutices, et herbæ potissimum proveniant, et tanquam gaudeant: et insimul quæ impinguationes, sive per stercorationes cujuscunque generis, sive per cretam, arenam maris, cineres, &c. maxime juvent; et quæ sint ex his pro varietate glebarum magis aptæ et auxiliares. Etiam insitio et inoculatio arborum et plantarum, earumque ratio; quæ scilicet plantæ super quas felicius inserantur, &c. multum pendet de consensu. In qua parte non injucundum foret experimentum, quod noviter audivimus esse tentatum, de insitione arborum sylvestrium, (quæ hucusque in arboribus hortensibus fieri consuevit) unde folia et glandes majorem in modum amplificantur, et arbores fiunt magis umbrosæ. Similiter alimenta animalium respective notanda sunt in genere et cum negativis. Neque enim carnivora sustinent herbis nutriri; unde etiam ordo Folietanorum[30] (licet voluntas humana plus possit quam animantium cæterorum super corpus suum) post experientiam factam, (ut aiunt) tanquam ab humana natura non tolerabilis, fere evanuit. Etiam materiæ diversæ putrefactionum, unde animalcula generantur, notandæ sunt.

[30] *Folietani*, the Vegetarians of the middle ages. They carried out the Pythagorean doctrine. (Cf. Juvenal. Sat. iii. 214.)

(γ.) Atque consensus corporum principalium erga subordinata sua (tales enim ii possint censeri quos notavimus) satis in aperto sunt. Quibus addi possunt sensuum consensus erga objecta sua. Qui consensus cum manifestissimi sint; bene notati, et acriter excussi, etiam aliis consensibus, qui latent, magnam præbere possint lucem.

(δ.) At interiores corporum consensus et fugæ, sive amicitiæ et lites, (tædet enim nos fere vocabulorum sympathiæ et antipathiæ, propter superstitiones et inania) aut falso adscriptæ, aut fabulis conspersæ, aut per neglectum, raræ admodum sunt. Etenim si quis asserat, inter vineam et brassicam[31] esse dissidium, quia juxta sata minus læte proveniunt; præsto ratio est, quod utraque planta succulenta sit et deprædatrix, unde altera alteram defraudat. Si quis asserat, esse consensum et amicitiam inter segetes et cyaneum[32], aut papaver sylvestre, quia herbæ illæ fere non proveniunt nisi in arvis cultis: debuit is potius asserere, dissidium esse inter ea, quia papaver et cyaneus emittuntur et creantur ex tali succo terræ, qualem segetes reliquerint et repudiaverint; adeo ut satio segetum terram præparet ad eorum proventum. Atque hujusmodi falsarum adscriptionum magnus est numerus. Quoad fabulas vero, illæ omnino sunt exterminandæ. Restat tenuis certe copia eorum consensuum, qui certo probati sunt experimento; quales sunt magnetis et ferri, atque auri et argenti vivi, et similium. At in

31 *Brassica*, Cauliflower, Κράμβη, ῥάφανον. "Vitis a caulibus brassicisque, si propter sati sint, ut a pestiferis et nocentibus refugere dicuntur." Cic. de Nat. Deor. II. 47.—This antagonism the Ancients thought went even farther than this; for they held that by eating Brassica they avoided the effects of drink. See Athenæus Deipn. I. p. 34 C—F.

32 *Cyaneus*, the Cornflower. The proper word is Cyanus, κύανος.

experimentis chemicis circa metalla inveniuntur et alii nonnulli observatione digni. Maxima vero frequentia eorum (ut in tanta paucitate) invenitur in medicinis nonnullis, quæ ex proprietatibus suis occultis (quas vocant) et specificis respiciunt aut membra, aut humores, aut morbos, aut quandoque naturas individuas. Neque omittendi sunt consensus inter motus et affectus lunæ[33], et passiones corporum inferiorum, prout ex experimentis agriculturæ, nauticæ, et medicinæ, aut alias cum delectu severo et sincero colligi et recipi possint. Verum instantiæ universæ consensuum secretiorum quo magis sunt infrequentes, eo majore cum diligentia sunt inquirendæ, per traditiones, et narrationes fidas et probas; modo hoc fiat absque ulla levitate, aut credulitate, sed fide anxia et quasi dubitabunda[34].

(ε.) Restat consensus corporum modo operandi, tanquam inartificialis, sed usu polychrestus: qui nullo modo omittendus est, sed sedula observatione investigandus. Is est coitio sive unio corporum proclivis, aut difficilis, per compositionem sive appositionem simplicem. Etenim corpora nonnulla facile et libenter commiscentur et incorporantur: alia autem ægre et perverse. Veluti pulveres melius incorporantur cum aquis; calces et cineres cum oleis; et sic de similibus. Neque tantum sunt colligendæ instantiæ *propensionis*, aut *aversionis* corporum erga misturam, sed etiam collocationis partium, et dis-

[33] The Moon's "consensus," (1) on Agriculture—in so far as she is thought to bring seasonable weather at her full—as in the case of the Harvest-moon especially.

(2) In Navigation—by her influence on the Sea, i. e. in the Tides.

(3) In Medicine—by her supposed power in certain complaints, of which belief the term "Lunacy" is a relic.

[34] This is exactly the phrase to explain Bacon's own mental state during investigation, "fides anxia et dubitabunda;" for Doubt is essential to the beginning of a healthy philosophy.

tributionis, et digestionis, postquam commista sint; denique et prædominantiæ post misturam transactam.

(7.) Superest ultimo loco ex modis septem operandi septimus et postremus; operatio scilicet per alternationem[35], et vicissitudines priorum sex: de quo antequam in singulos illos paulo altius fuerit inquisitum, tempestivum non foret exempla proponere. Series autem sive catena hujusmodi alternationis, prout ad singula effecta accommodari possit, res est et cognitu maxime difficilis, et ad opera maxime valida. Summa autem detinet et occupat homines impatientia hujusmodi tam inquisitionis quam praxeos; cum tamen sit instar fili labyrinthi[36], quoad opera majora. Atque hæc sufficiant ad exemplum polychresti.

LI.

Inter *prærogativas instantiarum* ponemus loco vicesimo septimo atque ultimo *instantias magicas*[37]. Hoc nomine illas appellamus, in quibus materia, aut efficiens, tenuis aut parva est, pro magnitudine operis et effectus qui sequitur; adeo ut etiamsi fuerint vulgares, tamen sint instar miraculi, aliæ primo intuitu, aliæ etiam attentius contemplanti. Has vero natura ex sese subministrat parce; quid vero factura sit sinu excusso, et post inventionem formarum, et processuum, et schematismorum, futuris temporibus apparebit. At ista

[35] "per alternationem," i. e. by bringing these six different methods to bear in judicious order on each subject, and so shifting that order as to gather different results—as, e. g. using Heat before or after pressure, &c.

[36] *Filum Labyrinthi* was the title of one of Bacon's lesser works.

[37] Twenty-seventh and last come Magical Instances. Those cases in which great and wonderful effects are produced by small and apparently inadequate causes. This class he seems to think the progress of science will reveal in greater abundance.

effecta magica (quantum adhuc conjicimus) fiunt tribus modis: aut per multiplicationem sui; ut in igne, et venenis, quæ vocant specifica; necnon in motibus, qui transeunt et fortificantur de rota in rotam[38]: aut per excitationem sive invitationem in altero; ut in magnete, qui excit acus innumeras, virtute nullatenus deperdita aut diminuta; aut in fermento, et hujusmodi: aut per anteversionem motus ut dictum est de pulvere pyrio, et bombardis, et cuniculis: quorum priores duo modi indagationem consensuum requirunt; tertius, mensuræ motuum. Utrum vero sit aliquis modus mutandi corpora per minima[39] (ut vocant) et transponendi subtiliores materiæ schematismos (id quod ad omnimodas corporum transformationes pertinet; ut ars brevi tempore illud facere possit, quod natura per multas ambages molitur) de eo nulla hactenus nobis constant indicia. Quemadmodum autem in solidis et veris aspiramus ad ultima et summa; ita vana et tumida perpetuo odimus, et quantum in nobis est profligamus.

LII.

Atque de dignitatibus sive *prærogativis instantiarum* hæc dicta sint. Illud vero monendum, nos in hoc nostro *organo* tractare logicam, non philosophiam[40]. Sed cum logica nostra doceat intellectum, et erudiat ad hoc, ut non tenuibus mentis quasi claviculis rerum abstracta captet et prenset, (ut logica vulgaris) sed naturam revera persecet; et corporum virtutes et actus, eorumque leges in materia determinatas inveniat; ita

38 This is only true in a sense. This "fortificatio motus," by multiplication of wheels, takes place at the expense of speed.

39 By "Per minima" may be meant, either "by means of the smallest Instruments," or "through infinitesimal Spaces." Probably here it means the latter.

40 Thus we see that throughout Bacon is mindful that the work of his Organon is not Philosophical but Instrumental. See Appendix D.

ut non solum ex natura mentis, sed ex natura rerum quoque hæc scientia emanet: mirum non est, si ubique naturalibus contemplationibus et experimentis, ad exempla artis nostræ, conspersa fuerit et illustrata. Sunt autem (ut ex iis, quæ dicta sunt, patet) *prærogativæ instantiarum* numero viginti septem. Nominibus: *instantiæ solitariæ: instantiæ migrantes: instantiæ ostensivæ: instantiæ clandestinæ: instantiæ constitutivæ: instantiæ conformes: instantiæ monodicæ: instantiæ deviantes: instantiæ limitaneæ: instantiæ potestatis: instantiæ comitatus et hostiles: instantiæ subjunctivæ: instantiæ fœderis: instantiæ crucis: instantiæ divortii: instantiæ januæ: instantiæ citantes: instantiæ viæ: instantiæ supplementi: instantiæ persecantes: instantiæ virgæ: instantiæ curriculi: doses naturæ: instantiæ luctæ: instantiæ innuentes: instantiæ polychrestæ: instantiæ magicæ*. Usus autem harum *instantiarum*, in quo instantias vulgares excellunt, versatur in genere aut circa partem informativam, aut circa operativam, aut circa utramque. Atque quoad informativam, juvant illæ aut sensum, aut intellectum; sensum, ut quinque *instantiæ lampadis*: intellectum, aut accelerando exclusivam formæ, ut *solitariæ*; aut angustando et propius indicando affirmativam formæ, ut *migrantes, ostensivæ, comitatus*, cum *subjunctivis*: aut erigendo intellectum, et ducendo ad genera et naturas communes: idque aut immediate, ut *clandestinæ, monodicæ, fœderis*: aut gradu proximo, ut *constitutivæ*: aut gradu infimo, ut *conformes*: aut rectificando intellectum a consuetis, ut *deviantes*: aut ducendo ad formam magnam, sive fabricam universi, ut *limitaneæ*: aut cavendo de formis et causis falsis, ut *crucis* et *divortii*. Quod vero ad operativam attinet; illæ practicam aut designant, aut mensurant, aut sublevant. Designant aut ostendendo a

quibus incipiendum, ne actum agamus; ut *instantiæ potestatis:* aut ad quid adspirandum, si detur facultas, ut *innuentes.* Mensurant quatuor illæ *mathematicæ:* sublevant *polychrestæ* et *magicæ.*

Rursus ex istis *instantiis* viginti septem, nonnullarum (ut superius diximus de aliquibus) facienda est collectio jam ab initio, nec expectanda particularis inquisitio naturarum. Cujus generis sunt *instantiæ conformes, monodicæ, deviantes, limitaneæ, potestatis, januæ, innuentes, polychrestæ, magicæ.* Hæ enim aut auxiliantur et medentur intellectui et sensui; aut instruunt praxin in genere. Reliquæ tum demum conquirendæ sunt, cum conficiemus *tabulas comparentiæ* ad opus interpretis circa aliquam naturam particularem. Sunt enim *instantiæ prærogativis* istis insignitæ et donatæ, animæ instar inter vulgares instantias comparentiæ: et, ut ab initio diximus, paucæ illarum sunt vice multarum. Quocirca cum *tabulas* conficimus, illæ omni studio sunt investigandæ, et in *tabulas* referendæ. Erit etiam earum mentio necessaria in iis quæ sequuntur. Præponendus itaque erat earum tractatus.

Nunc vero ad *adminicula* et *rectificationes inductionis*, et deinceps ad *concreta*, et *latentes processus*, et *latentes schematismos*, et reliqua, quæ *aphorismo* 21. ordine proposuimus, pergendum; ut tandem (tanquam curatores probi et fideles) tradamus hominibus fortunas suas, emancipato intellectu, et facto tanquam majore; unde necesse est sequi emendationem status hominis, et ampliationem potestatis ejus super naturam. Homo enim per lapsum et de statu innocentiæ decidit, et de regno in creaturas. Utraque autem res etiam in hac vita nonnulla ex parte reparari potest; prior per religionem et fidem, posterior per artes et scientias. Neque enim per maledictionem facta est creatura prorsus et

ad extremum rebellis: sed in virtute illius diplomatis, *In sudore vultus comedes panem tuum*, per labores varios, (non per disputationes certe, aut per otiosas ceremonias magicas) tandem et aliqua ex parte ad panem homini præbendum, id est, ad usus vitæ humanæ, subigitur[41].

[41] It is worth noticing once more how Bacon separates and distinguishes the offices of Religion and of Knowledge. This conclusion to his great work is not the language of an Atheist or of a Materialist.

APPENDICES.

APPENDIX A.

ON THE WORD "AXIOM."

Axiom, ἀξίωμα, (ἀξιόω, ἄξιος, ἄγω in the sense of *weighing*) is strictly *that of which one is weighed* (or *counted*) *worthy, an honour* or *dignity*. Thence it passes on to the sense of *that which is thought worthy or fit, a decision.* And from one of these senses it arrives at the Logical use—of *a proposition fit to be taken as a basis of demonstration.* In this sense we find the term used by Aristotle in his Logical treatises. It is with him the title of the Major Premises of Demonstrative Syllogisms. He means by it those universal statements which are in necessary matter, and which no one would think of doubting. In this sense the schoolmen have also used the Term, rendering it into *Maxima* (*Sententiarum*) (whence our term "a Maxim") or, somewhat absurdly, into *Dignitas.* (Sanderson's Logic, III. xii.) From this sense to that in which the Mathematicians use it there is but a short step; and with them it means always *a self-evident Proposition.*

In modern times we find the Term used in two senses, which correspond nearly with the Logical and Mathematical usages just given. The one sense is almost equivalent to that of "Principle" (nearly the Ἀρχὴ of Aristotle). "Principle" is rightly used of "all assumptions (founded either on fact or Hypothesis) on which as a datum a train of reasoning proceeds." (Sir W. Hamilton.) Thus it would, in its full extent, include Axioms in their more limited sense: embracing (e.g.) the Physical "principle" of the Continuity of the Laws of Nature; the belief in our own Identity, &c.; and such ge-

neral statements of special Phenomena as "the angle of Incidence of Light is equal to the angle of Reflection"—an optical "Principle" on which much depends. The Definitions of Geometry may be termed its "Principles." If then we take Axiom in this sense, we have the authority of Bacon and of Sir Isaac Newton on our side; against us we shall find Dugald Stewart's Philos. of the Human Mind, part II. chap. i. § 1, 2. also Locke, Essay on the Human Understanding, bk. IV. chap. vii. (where he calls Axioms *Maxims*), and Mill's Logic, part III. chap. xxiv. § 7. These all nearly agree in holding that Axioms are only those direct and perfectly simple Inductive Truths which, when once stated, are felt (by the structure of the mind combined with experience, as some say; by the "nihil contrarium," as others hold) to be self-evident.

Into the question of their proof depending partly on the constitution of the Human mind, or of their entire derivation from the outer world (the point at issue between Mill and Whewell), I need not enter. And as this note is intended to explain Bacon's use of this term, we may now pass on to find instances in which he takes "Axioma" as equivalent to "Principle;" as any thing above particulars, even in the lowest degree—any general statement, even of the lowest amount of generality. The chief place for the use of the Term in the Novum Organon is I. 103—105, where Bacon treats of the discovery of Axioms by means of the new method of Induction. There we find him speaking of "Axiomata minora" or "infima," which do not differ very much from bare experience. There is in them a little more consciousness of a law or general statement than there would be about bare experience, whose conclusions would be exactly the same, probably, but not got at so definitely. Then there are "Axiomata media"—holding an intermediate rank in generality between the above-mentioned lowest Axioms, the immediate results of bare experience, and the highest Axioms, or most general principles in any Art or Science the "generalissima" of Bacon. And these last, too, must be distinguished from the abstract and conceptional Axioms of the then prevailing systems of Sciences. And these "generalissima" will include these Axioms noticed in the "De

Augmentis Scientiarum"—"Axioms or profitable observations as fall not within the compass of any of the special parts of Philosophy or Sciences, but are more common and of a higher stage." These Axioms he there collects together, and regards as a basis for a "Prima Philosophia." But for all the concerns of human life, the intermediate Axioms are looked on by him as the valuable ones. We might illustrate from Optics, taking such propositions as "the diffusion of light from a luminous body takes place equally in every direction"—or "rays of light are capable of both Reflection and Refraction." These would be the lowest class of Axioms. When, by consideration of cases, we had concluded that these Laws are true, then such "Axioms" as the following might be started as a lower class of "Media"—that "the diffusion of light follows a fixed law." Then that that law is, that "the Intensity of light varies inversely as the surface illuminated"—or that the surface illuminated varies as the distance from the luminous body. Or, to take the other low Axiom, we might pass on to shew, by Induction, that "the angle of Incidence = the angle of Reflection"—or, that "Refraction takes place at a fixed angle differing according to the substance through which the ray passes;" and so on.

In all these it is quite clear that Bacon means by Axiom nothing more than any general principle of the lowest degree of generality. And in this he is followed by Sir Isaac Newton, who gives the title of Axiom to all "general experimental Truths"—to the "Laws of Motion," which are purely inductive, and not at all "self-evident" truths—to the principles of Optics, &c.

Whereas, let it be remembered, modern writers strictly limit the Term to all "Laws of Resemblance" true of *all* phenomena alike; independent of Causation; and so differing from such a principle as that given above, "that the angle of Incidence = the angle of Reflection," inasmuch as this latter is only true of certain special phenomena.

How the Induction, which ascends by platforms of "Axioms," stories one over another in regular order, can be the same with that specimen of "the discovery of Form" given in Bk. II. 10—20, ending in the "Vindemiatio Prima," or how far poste-

rity has ratified the great philosopher's "Scala Intellectus," it is not for me to say. Some few Sciences would seem to admit of such an arrangement; but this would not seem to be so much for discovery, as for after-use. But, generally speaking, genius still has play, and Sciences and Arts grow by far different methods than this formal system: and had Bacon lived to see (e.g.) the path of Chemistry and its methods of discovery, he would have repeated the noble words which conclude the First Book of the Novum Organon, "nos, qui mentem respicimus, non tantum in facultate propria, sed quatenus copulatur cum rebus, *Artem inveniendi cum inventis adolescere posse* statuere debemus."

It is just worth noticing that in one place in the Nov. Org. (II. 27 ad fin.) Bacon, in speaking of the Mathematical Axiom, "things which are equal to the same thing are equal to one another," calls it a *Postulate*, so marking off most definitely his usage of the term Axiom from the Mathematical usage.

APPENDIX B.

ON THE ANCIENT SYSTEM OF LOGIC.

As Induction is expressly treated by Aristotle and the older Logicians as a variation of the Syllogistic Method, the whole discussion of the Ancient Logic may at first be conveniently narrowed to a consideration of that process; especially as I shall have occasion to refer to Ancient Induction as compared with Modern, in Appendix D. It is not necessary to say much as to that view of the Syllogistic Process, popular once, but now abandoned, which regarded it as a Method for the systematic discovery of Truth. This "brandishing of Syllogisms," as Locke terms it, this exorcism of Nature by means of formulas, has passed away; and the defenders of Syllogism now stay themselves upon the position that "Logic, though it gives us no new Truths, still helps and directs us while we are engaged upon the consideration of things." This is the old

distinction, in fact, "ars instrumentalis dirigens mentem in cognitione, (not in *cognitionem*) rerum." Before considering this position, it will be as well to state, that whatever view we may take of Syllogism, as a Method, or even as an Instrument, we do not for one moment doubt its usefulness as a means of education; for it sharpens and clears the Intellect, and gives to young men greater power of attention, and of analysis of the thoughts of others; and so is most fitly retained in a system of education, which regards not the amount of information to be acquired, so much as the mental power to be brought into play or improved.

Is then the Syllogism a sufficient Instrument for the guidance of the Human Mind in the discovery of Truth? This is the question which Bacon asked, and answered in the negative. In other words, can man by application of Syllogism to his otherwise unaided reason and senses arrive unerringly, or even proximately, at the truth? Does the Method reject error, and strengthen truth? is it a self-regulating machine in any degree? For unless it be all this, it must be regarded as insufficient for the purposes we have in view. It is, indeed, a clear analysis of certain "Laws of Thought," of certain functions of the mind of Man, and no one ought to wish to take from Aristotle the credit due to him for his acuteness in detecting the processes of reasoning; although opinions may differ as to his manner of treating his subject, his obscure method of illustration, and his division of the application of Syllogism to "Demonstrative" and "Contingent" (or "Topical") Matter.

The Syllogistic process is based upon one Axiom only, and that Axiom upon the relations between Whole and Part. (For we pass by all distinctions between Predication of *Inhesion* or of *Extension;* and regard the matter, as it should be taken, absolutely.) "Whatever can be predicated of a Whole can be predicated of all parts included under that Whole; whatever cannot be predicated of the Whole cannot be predicated of the parts." Let us allow this to be as simple as it looks; let us allow too that it will be directly acknowledged as a prime law, holding in Logic as in everything else. What then remains for us to do? to apply the rule to things. We may indeed

cling to technical language, and arrive at certain symbolical results; just as in Algebra, having got one expression of Equality, we go on till we obtain another. But when this is reached we are no nearer our end, unless we go on to fit things to our symbols. The Dictum de Omni et Nullo is perfectly futile, unless that *Omne* and *Nullum* give place to actual things. And the application of the syllogistic process will be the taking things, (be they genera, species, individuals, conceptions, what they may,) and trying to discover fresh relations between them by means of that process. Logic then does not provide us with our knowledge of these things; nor does it connect them together; it only affirms that when connected together in certain ways certain results must follow, certain connections be discovered. It does not profess to touch upon the most important branch of human knowledge, the gathering of conceptions from things; it does not profess to connect those conceptions, (or to provide us with principles,) it does not even give us a means of testing the truth of our judgments. It demands two already formed judgments, and from them it deduces a third; one which is already involved in the foregoing two; and which contains nothing really new.

But Physics demand more than this. They require a Method which shall take charge of particulars, and watch over the growth and clearness of our conceptions; they must be tended regularly and from the beginning: this the Aristotelian Logic was utterly unable to do; and consequently no truth was ever obtained through its instrumentality. Useful it is for arrangement; and as a secondary method in the growth of sciences; but placed where it is placed by Aristotle, it must fail. Had it failed and been thrown aside, or applied, as Deduction is now being applied in modern sciences, no evil would have resulted; but it obtained such holds on men's minds that a great reformer, stern, and without respect for age and name, was needed, before its empire could be brought to an end. Such a reformer, in an age when thought was just freeing itself from the trammels of centuries, was Bacon. We must pardon his excessive anger against Aristotle, and his unfairness towards him, when we remember what interests were at

stake, and in what a thraldom the old Logic held all the realm of knowledge. See D. Stewart's Phil. of the Human Mind, part II. chap. iii. Locke's Essay on the Human Understanding, Bk. iv. chap. 17; Mill's Logic; Hallam's Lit. of Europe, part III. chap. iii. § 77 (note).

APPENDIX C.

BACON NOT AN UNBELIEVER.

Bacon's belief in Revelation has been denied by two parties. (1.) By the supporters of blind belief, the antagonists to a pure rational faith, who dislike or dread any appeal to God's world, of whom Le Maistre is the leader; he having written an "Examen" of Bacon's works, and having condemned him as a blasphemer and an Atheist, (and with him doubtless all the followers of Physical studies—

> —"omnes uno ordine habetis Achivos
> Idque audire sat est.")

(2.) By those modern thinkers who are termed Positivists, and who, with Auguste Comte at their head, have elaborated a material system of the Universe, whose tendency, if not its definite language, is toward absolute Atheism. These men have boldly claimed Bacon as their friend and ally. Not that they would affirm, perhaps, that he was consciously an Atheist, or that the trammels of position or education had fallen off from him: but that his mind was essentially materialist; that he was prepared with a physical system of Ethics, and with a Godless system of Physics; and that had he lived in later days, he would have thrown off the mantle of religion as readily as he abandoned the awkward subtilties of scholastic language.

It is sad to see blind Superstition leading blind Infidelity till both fall into the ditch. Superstition denounces Bacon as her natural enemy; and as she considers herself alone the favoured of God, denounces him as God's enemy as well: Atheism re-

joices over him, and claims him as a friend and a brother. The former may be sad, the latter is fearful. The former is easily confuted by an appeal to fact, and to Bacon's own earnest and wise language: the latter, as we have seen, tries to hinder us from using Bacon as a witness against it; or, as we would rather say, as a witness for himself.

Every fair mind must allow that the burden of proof rests with the Positivists. Bacon's language must be proved to be the same with theirs; for the position he held, and the times he lived in, allow of no a priori presumption that his views coincided with theirs. It is true that the materialist theory of the Universe was in existence: modern forms of error are usually modifications of ancient forms; and our modern Materialists are the Atomists of the Ancients, with the modifications introduced by the modern Inductive System of investigation: but in Bacon's days it was not an acknowledged view, and unless he can be shewn to have held language such as declares his mind to have been materialist, the Positivists have no right whatever to claim him as theirs. To most persons those few passages from his writings which I shall presently refer to will be, I think, quite conclusive against this; for they shew a warm as well as an exact Faith: but it will be as well to investigate briefly the grounds on which he has been claimed as a Materialist.

First, then, his statements as to an Inductive method for the discovery of facts in man's Moral Nature are alleged, as shewing that he took a materialist view of the functions of the moral life of man, as though he held that feelings are nervous sensations, &c. Then he speaks most favourably of Democritus, and shews great partiality towards the Atheistic Philosophy of the Ancients. Then he speaks of a "commune vinculum animi et corporis," as though mind and body were alike in kind, alike material. He also regards Final Causes with little favour.

Does this not seem a narrow foundation for such a structure, even granting the monstrous position that we may allow that Bacon's language one way is honest, and the other way not?

An Inductive treatment of moral phenomena in no way

obliges a materialist view of morals: unless indeed one so expand the term Matter as to break down all distinctions of fact: for the man who tells me that digestion and thought are alike in kind; the former a process of the stomach, the latter of the brain; tells me what he cannot prove, and what I am not bound to accept. Wherever we discern a fact we may register it and think upon it: and there are facts of intellectual or moral appreciation as well as of physical sensation. And he who says that because these are all facts, they are all material, either defines his terms badly, or assumes what he has no right to assume, and dictates in the presumption of ignorance.

With regard to Bacon's admiration for Democritus and the Atheist Philosophy of the Ancients: we must remember what that Philosophy stood over against; and we shall immediately discern that Bacon's liking for it arose, not from its Atheism, but from its inductive and searching character. And more, Bacon is himself careful to distinguish between *Nature* (i. e. external Nature) and the thinking powers of man. (See Nov. Org. II. 2. "Licet in *Natura* nihil vere existat præter corpora individua—in *doctrinis* tamen," &c.) So that we are bound to believe that his respect for Democritus was limited by the bounds of external Nature.

Lastly, as respects his views on Final Causes; he particularly refers, in his judgment on them, to the discovery of Physical truths; and not at all to moral subjects, as may be seen by reference to his remarks on Causes in the Advancement of Learning. He foresaw the very use of his objection to them, that has been made, and guards against it. Ineffectually, it appears. For men who are interested in making out his character as an unbeliever, do not fairly put side by side his different statements on the same subject; but prefer to use such only as seem to make for their views. But if any one will honestly let Bacon here, as elsewhere, speak for himself, he will acquit him of any desire to injure the truths of Christianity, by his disregard of Final Causes. This point I have also treated of at some length in the notes upon the text, II. 2, to which I refer my reader.

I gladly turn from this unsatisfactory method of dealing with

Bacon's opinions to the simpler and pleasanter task of answering those whose superstitious reverence has been hurt at the boldness of this great Prophet of Nature. Let them hear what he says himself of his Faith; and they will not see much to find fault with. And I am sure there will be none, unless perhaps it be a few dreamers eager to win the support to their fancies they would gain from such a name as that of Bacon—who will refuse to accept the evidence from his own mouth, which I am glad to be able to lay before them.

The passages to which I refer are not many; but they are weighty. They are Nov. Org. I. 89; the first part of the Adv. of Learning, under the title of "Divine Proofs;" the essays on Atheism and Superstition; and lastly, a passage which I will transcribe at length, as the Preface to the great Instauration, from which it is taken, is not likely to be in every one's hands.

The first two passages (which are very similar), viz. that from the Nov. Org. and that from the Adv. of Learning, draw the distinction between the Revelation of God's Will, i. e. Holy Writ; and the Revelation of His Power, i. e. Nature—and Bacon is most careful to declare that natural Philosophy "merito religioni donatur tanquam fidissima ancilla;" so setting Religion in the higher place. The connection between the two, and the fact that as the "Book of Nature" is God's work, it must have tendencies and objects that are good, are fully worked out in Bp. Butler's writings. He seems to have caught much of that spirit which Bacon's works honestly studied will infuse. The chief object of the observations on Religion in connection with Physics in the Nov. Org. is negative; i. e. to do away with fears, lest the two should prove opponents; an object about which, if he really had a materialist end in view, he would scarcely have troubled himself.

If we look at the essays on Atheism and Superstition, we shall find in the former a rebuke to those who are desirous of reducing the human mind to a materialist standard, and that too couched in no doubtful language. In the latter we see Bacon's objection to that ill-grounded faith, which is but a form of unbelief, and which is represented by such writers as Le Maistre.

He seems in those essays to be defending the truth between the two antagonist extremes which he foresaw.

And, lastly, I will quote at length (and with it conclude this Appendix) the famous prayer from the Preface to the Instauration. The clearness of its language, its gravity and beauty, and the striking manner in which he prays against the snares to which the Physical student is liable, render it a singularly interesting composition, one too which might well be commended to the notice of all those whose days are spent in the discovery and arrangement of the truths of Nature.

"Quamobrem, quum hæc arbitrii nostri non sint, in principio Operis, ad Deum Patrem, Deum Verbum, Deum Spiritum preces fundimus humillimas et ardentissimas, ut humani generis ærumnarum memores, et peregrinationis istius vitæ, in qua dies paucos et malos terimus, novis suis Eleemosynis per manus nostras familiam humanam dotare dignentur. Atque illud insuper supplices rogamus, ne humana Divinis officiant; neve ex reseratione viarum sensus, et accensione majore luminis naturalis, aliquid incredulitatis et noctis animis nostris erga Divina mysteria oboriatur: sed potius, ut ab intellectu puro et phantasiis et vanitate repurgato et Divinis Oraculis nihilominus subdito et prorsus dedititio, fidei dentur, quæ fidei sunt. Postremo, ut, scientiæ veneno a Serpente infuso, quo animus humanus tumet et inflatur, deposito, nec altum sapiamus, nec ultra sobrium, sed veritatem in caritate colamus."

APPENDIX D.

ON INDUCTION—ANCIENT AND MODERN.

The differences between Induction, as it was regarded by Aristotle, and as it is now applied, are usually stated as follows. The Ancient was formal and syllogistic: the Modern is not formal; and is material, though it has Method, to a certain extent. The Ancient professed to seek the knowledge of Causes; and practically was satisfied with very abstract gene-

ralizations: the Modern makes no such professions, but appeals to the facts of Nature as they are. Finally, (and this will be seen to be the most important difference,) the Ancient was quite content with *Observation*, and seemed to have little or no notion of *experimental* inquiry: the Modern uses *Experiment* continually to carry on and enlarge the result reached by *Observation*. To these heads we may subjoin Bacon's statements; which might be classed under them, but which, for distinctness' sake, had better be kept separate:—Ancient Induction proceeded by "simple enumeration" of all known cases: Modern is content with a selection of Instances: the Ancient leapt immediately from the lowest particulars to the highest principles: the Modern ascends "gradatim," "per scalam ascensoriam," through intermediate Axioms to the highest truth.

Before discussing these points more at length, it will be well to state the distinction, obvious enough in itself, yet often overlooked, between a *process* of the mind, and the *Analysis* of that process. Aristotle, with the precision of his Logical power, has regarded the latter, both in his treatises on Dialectics and Rhetoric, and in his statements on Induction: and he it is who has given rise to the remark that "Ancient Logic is an analysis of our powers and processes of thought, while the Modern Logic is an application of those powers to things." This will at once lead us to the consideration of the first of the points of difference. "The Ancient Induction was formal;" i. e. Aristotle analyses the process, and lays it down, that it is syllogistic in form. Let us turn to his statements on the subject. They are to be found in two places especially, viz. Topica I. x. 2. *'Επαγωγὴ δὲ ἡ ἀπὸ τῶν καθέκαστα ἐπὶ τὰ καθόλου ἔφοδος· οἷον, εἰ ἔστι κυβερνήτης ὁ ἐπιστάμενος κράτιστος, καὶ ἡνίοχος· καὶ ὅλως ἐστὶν ὁ ἐπιστάμενος περὶ ἕκαστον ἄριστος.* And here, if one can judge from the illustration, Aristotle scarcely dissevers Induction from Analogy. The other passage, (and from its position in the Prior Analytics, which are a formal treatise, we shall look for accuracy of statement,) is in the Anal. Pr. II. xxv. 2. *'Επαγωγὴ μὲν οὖν ἐστι, καὶ ὁ ἐξ ἐπαγωγῆς συλλογισμὸς, τὸ διὰ τοῦ ἑτέρου ἄκρου θάτερον ἄκρον τῷ μέσῳ συλ-*

λογίσασθαι.——4. Δεῖ δὲ νοεῖν τὸ Γ τὸ ἐξ ἁπάντων τῶν καθέκαστα συγκείμενον· ἡ γὰρ ἐπαγωγὴ διὰ πάντων. 5. Ἔστι δὲ ὁ τοιοῦτος συλλογισμὸς τῆς πρώτης καὶ ἀμέσου προτάσεως. 6. Ὧν μὲν γάρ ἐστι μέσον, διὰ τοῦ μέσου ὁ συλλογισμός· ᾧ δὲ μή ἐστι, δι' ἐπαγωγῆς. 7. Καὶ τρόπον τινὰ ἀντίκειται ἡ ἐπαγωγὴ τῷ συλλογισμῷ· ὁ μὲν γὰρ διὰ τοῦ μέσου τὸ ἄκρον τῷ τρίτῳ δείκνυσιν· ἡ δὲ διὰ τοῦ τρίτου τὸ ἄκρον τῷ μέσῳ.

I have transcribed the passage at length; for it includes all the important points of Ancient Induction. First, we have the statement of the *Syllogism* ἐξ ἐπαγωγῆς, where Aristotle seems to draw a distinction between the process of gaining knowledge and the formal arrangement of that knowledge. Then he goes on to do away with such distinction by adding οὕτω γὰρ ποιούμεθα τὰς ἐπαγωγάς: and he lays it down that Induction is proving the connection between "Middle" and "Major" by means of the "Minor:" i. e. if an ordinary Syllogism runs thus,

All B is A,
All C is B;
∴ All C is A:

then Induction will run thus—

All C is A,
All C is B;
∴ All B is A.

Now any person ordinarily acquainted with Logical forms will see immediately that this is Logically incorrect; that, in fact, it involves an "Illicit process of the Minor." Therefore it is that Aristotle adds Δεῖ δὲ νοεῖν τὸ Γ τὸ ἐξ ἁπάντων συγκείμενον, in other words, the principle of Simple Enumeration (ἡ γὰρ ἐπαγωγὴ διὰ πάντων) is introduced, and the whole validity of the process is based upon the assumption of the "convertibility of the Minor," or, in English, upon the assumption that it is possible to exhaust and catalogue all cases on any subject: the τρίτον, or *Minor* in the Deductive Syllogism, (which is used as the *Middle* Term in the Inductive,) is really this enumeration of all possible cases. To explain; let us take Aristotle's own illustration.

Deductively,

B All creatures without gall	are	A longlived.
C The horse, &c.	is	B a creature without gall.
C The horse, &c.	is	A longlived.

This Inductively will be

C The horse, ass, mule, man, &c.	are	A longlived
C The horse, ass, mule, man, &c.	are	B *all* the animals without gall.
B All the animals without gall	are	A longlived.

And in another place Aristotle confirms this principle of simple enumeration by saying, ὅτι πᾶν οὕτως ᾧ μηδὲν ἄλλως—i. e. "cui nihil occurrit in contrarium." Anal. Post. II. vii. 1.

This is the Ancient Induction: a Syllogism in the Third Figure with a necessary condition attached, which, strictly speaking, takes it out of the domain of Logic altogether.

This is very different from the Scholastic Induction which Aldrich, or that which Abp. Whately have tried to explain. Aldrich's Induction is "Syllogismus cujus Minor reticetur"—a sort of Enthymeme: and the Minor is the assumption by the mind that the cases before us may stand for all cases. He thus throws Induction into *Barbara* and reduces it to precise Logical language. I presume that the meaning of his method of analysis is simply this—that having gathered certain instances, we observe that a certain quality is attached to each of them—"Hic et iste et ille magnes trahit ferrum"—and then we assume that till the contrary is proved in any instance, this quality may be believed to be present in all cases; i.e. "Omnis magnes est hic et iste et ille: Ergo; omnis magnes trahit ferrum."

This is then, practically, a somewhat altered way of regarding Ancient Induction: but is still really "per enumerationem simplicem" of all known cases.

Abp. Whately holds that Induction is a Syllogism in Bar-

bara with a suppressed Major; which Major is, "What is true of each of these cases is true of all:" which in itself seems to offer no solution: for it falls under the same head with Aristotle's and Aldrich's, as involving simple enumeration.

Is then this "Inductio per simplicem enumerationem" a philosophical absurdity? By no means. Whether we accept Locke's view that Mathematical Axioms are so established, or not, there are still many things the truth of which has been affirmed solely by continual observation of unvarying phenomena. Our knowledge of the fact that two and two make four, or that four and one make five, may or may not be referable to this principle; at any rate, the conclusions reached by the unscientific are almost all of this kind. It is a lower sort of knowledge, but it is knowledge as far as it goes. Thus the observation of years will teach a sailor that the tide will ebb and flow twice in a given day: this he is sure of without being able to give a reason for it; the scientific man will know the fact, and its "antecedent;" viz. the action of the Masses of the Moon and Sun upon the surface of our Planet. It fails, however, because it is indiscriminating, and "precario concludit, et periculo exponitur ab instantia contradictoria." (Nov. Org. I. 105.) It is indiscriminating; for it seems to draw no distinction between those general propositions, which are merely statements of what are called *accidents*, and those which involve some knowledge of the *essential* Nature, or Law of existence of a class. Thus, Ancient Induction would treat with equal respect the Universals, "All crows are black," and "All particles attract one another with a force which varies inversely as the square of their distance." It also lacks for discriminative power, in not discerning the difference between the most abstract "notionalia Axiomata," and the intermediate generalizations. All its generalizations are, so to speak, supposed to lie in one plane. For the precarious position of its conclusions, it is enough to remark that the mere collocation of observed facts, and the discovery of a formula to express their points of resemblance, can never give more than an imperfect certainty. There must always be behind it the fear of a contradictory instance. What if we discovered a white Crow? For this failure of

Ancient Induction, I may refer the reader to Mr. Mill's Logic, Bk. III. chap. 3. §. 2, 3.

What then did Bacon propose as a substitute for this unsatisfactory system?

He sought for a Method which might enable all men (be their natural faculties never so different) to attain the knowledge of truths with equal ease and certainty. His Method was to unfold the *Form*, or real nature (Natura naturans) of things to man's gaze; and enable man to apply his knowledge to the production of new fruit of inventions, and almost of creations in Art and Science. His Method was then not ascending only, but descending also; it had a Deductive as well as an Inductive Logic; it was to dissect Nature, that it might the more surely recompose and rearrange her parts.

There can be nothing more grand than this scheme. It was to be a Logic of universal application: Logic itself, or (as I suppose he meant) mental phenomena of every kind; Morals; Politics; all these, as well as Physics, were to display their treasuries of Truth before the eyes of him who held the key provided by the New Method. Before the eye of the Philosopher the old limits passed away, and he saw a promised land, and the glory of it: the Phantoms of the past he saw flying from the light of that day, in whose grey dawn he was the brightest star; and no wonder that his imagination saw the Forms of truth peopling the awakened world. It is as he foresaw, and it is not. Much that he predicted has been verified; but not as he expected. His Method has brought in all modern Science; and yet it is cast aside.

We do not possess all the Method as Bacon meant to unfold it; still we have enough to judge fairly, enough to enable us to see his object. For the Novum Organum was intended to have been divided into two great parts. (1) The *Pars Destruens*, and the statement of the end, and an illustration; (i. e. Nov. Org. I. 1.—II. 20.) and (2) the nine processes which he entitles the "Helps of the Intellect," of which he has only completed the first, viz. (II. 22—52.) the *Prerogatives among Instances*.

From the famous Aphorisms, I. 100—106, we draw most of

our knowledge of Bacon's system. Thence we learn (1) The futility of Ancient Logic, its "mera palpatio," its groping without light to guide it; (2) The necessity of a "Literate Experience,"—or of the systematic committal to paper of all facts and results which may come under notice; (3) The ascent in generalization from particulars, through intermediate Axioms, to the highest truths, "per scalam veram et per gradus continuos."

(1.) Of the first of these heads, we need only stay to give Bacon due praise for the wise boldness with which he attacked the Ancient Process. There was clearly nothing to be hoped for in Physics (or in any other branch of science) so long as the old Scholastic distinctions and cramped views were dominant. And we cannot too much admire the bravery which could face a world in arms; however much we may regret the strange jealousy which refused to consider those as friends who were doing so much for Experimental Philosophy, and whose minds had intuitively grasped the same thoughts, and followed the same lines of discovery which he was himself proposing for men's consideration and adoption.

(2.) For the *Experientia Literata*, the consequence of the spread of learning, and of printing, we may observe that Bacon himself gives us an example of it in his Tables on Heat, and in his "Vindemiatio Prima," II. 11, 12, 13, 18, and 20. It was the putting results on record, for the good of posterity.

(3.) Now we come to the chief principle of the Method—the successive steps.

The question which first meets us here is, How do we obtain any of these steps? Is it by the Simple Enumeration condemned above? or by selection of cases affirmatively? or by rejection of negatives?

As to this, Bacon provides us with no thoroughly definite answer. It is hard to see how the first Table (II. 11.) of "Instantiæ convenientes in natura calidi" is other than a simple enumeration, so far as it goes. Bacon provides us with no real rules for selection; nor does he seem to have been struck by the hopelessness of attempting to catalogue so in-

finite a variety of particulars. He is more definite on the necessity of *negatives*, of rejection and exclusion of all Natures which do not exhibit the required Nature. Passing by these questions as very vaguely answered, if answered at all, we come to the doctrine of successive steps, the most distinctive and satisfactory part of Bacon's Method. For it was by pointing out the need of discrimination between different *orders* (to speak Mathematically) of Generalization, that Bacon led the way to the construction of Modern Sciences. By such successive stages Astronomy, Optics, Mechanics, have been built up to their present noble height; and Dr. Whewell has been at the pains (Phil. Ind. Sc. Bk. xi. ch. 6) to construct a pyramid, shewing the gradual progress of Astronomy. By this process generations have gone on adding to the amount of certain knowledge in the world; and applying the results of Induction to the amelioration of man's life.

It only remains that I should notice Bacon's great worth as an *Experimentalist*. He was not, indeed, the first man who so "interrogated Nature;" but he gave to Experiment great prominence; and has left us descriptions of many attempts, which we may smile at for their rudeness, but which, nevertheless, were themselves in the right direction, and led men onwards. And we must not underrate this excellence, for, as I said before, Experiment is really, as much as one thing can be, the cause of the marked success and progress of the physical sciences in modern times.

To sum up; Bacon's Induction is good, as it opposes the ancient and scholastic systems; as it introduced regularity of registration of results; as it took wider views of the relationship between the branches of science; as it discriminated between the orders of generalization; as it arranged those orders; as it based itself upon dissection and interrogation of Nature by means of Experiment. His Method failed, however, in its not acknowledging the need of a "Mental Initiative," and of that sagacity which distinguishes the able man from the weak; in its cumbrousness of Tables, Prerogatives, Rectifications, &c. which (as Coleridge, Friend II. Essay 8. notices) if followed obediently would have "expended the life of an

antediluvian patriarch, in merely polling the votes." Lastly; if we take the higher view of the term *Form*, his Method has failed to bring us nearer to the discovery of it.

Let me add a few words on Modern Induction; the subject is a long one, but I will try to be brief. Its main object is the discovery of Laws of Nature; and by these Laws, taking the term in a wide sense, are meant those general facts which observation and experiment teach us to lay down as invariable. Thus the Law of Gravity, the Law of Refraction, the Law of Polarization, the Law of Actinism, these are all short statements of uniform facts, some more and some less general in their application, but all invariable in their action, so far as we know. From this we gather, that Modern Induction does not seek for Causes, as the Ancient was said to do, but is content to obtain those "generalizations from experience" which form the groundwork of the Sciences. Of these general expressions some are attainable by analysis, as many of those of Chemistry are; others require shrewdness, sagacity, and power of inventing Hypotheses, which may account for the Phenomena. And it is this hitting upon the Law to answer to the isolated facts in our possession which distinguishes Modern Induction from Ancient; and it is in this that the genius of modern times peculiarly shews itself. Thus Kepler hit at last upon an Hypothesis which accounted for the Orbit of Mars, and the Elliptical Motion of that Planet having once been ascertained, the Law was soon shewn to be applicable to the other planets as well. And it was afterwards beautifully connected with the Law of Gravity by the demonstrations of Central Forces: a fine instance of Bacon's "quando Physicum terminatur in Mathematico."

From this it will appear that the prominent conception in Modern Induction is not that of Method. In fact, it is not at all clear that we may use any such phrase as "the Method of Modern Induction;" for it is very doubtful whether the prosecution of Modern Science can ever be put under one law or set of laws. Each wise student of Nature has sought his inspirations from her, by observing her doings, and by experiment upon them; by judicious selection of critical instances;

by quickness in seizing the principle running through similar cases; but I doubt whether any great discoverer has ever done what Bacon seems to have thought would be done universally, *i. e.* set before himself a regular process of successive steps, by which to compel Nature to answer at his bidding.

It is perhaps the case that each branch of knowledge has its own Method, just as each has its own Instruments. The Astronomer, whose science obliges him to keep to Observation, observes the planets and stars after a fixed rule. If he must verify a calculation, he has a Method by which to do it. So the Chemist analyses in certain ways; but I doubt whether Faraday has ever said to himself, "Now let me follow the great Inductive Method." As the Astronomer has his telescope, and his prepared papers, &c., so the Chemist has his crucibles, his retorts, his air pump, &c., and their Methods differ just in the same way. And the same seems to hold of other sciences; optics, geology, mineralogy, and crystallography; so too, in their way, it will be found to be the case with the investigation of ethical questions, and of social and civil problems. The Methods of Chemistry or Anatomy would fail, if applied, for example, to the action of the Will, or to the study of Commercial problems: still these admit of Inductive treatment, within due limits, and are gradually being discussed upon other than *a priori* grounds.

In a word, Modern Induction is distinguished by its lower aim; for it disclaims all presumptuous discussion of Causes; by its patience and fidelity of observation of facts; by its judgment in experiments; by its sagacity in choice of cases; by its genius in hypothesis; in other words, by its absence of Method, and its constant and humble appeal to Nature herself.

The reader is referred to Dugald Stewart, Phil. of the Human Mind, Part II. chap. iv. sect. 1, 2; to Dr. Whewell's History of the Inductive Sciences, and to his pamphlet on Induction; to Mill's Logic, Bk. III.; to Coleridge's Friend, sect. II. essays 8, 9; and to Sir J. Herschel's Discourse on the Study of Natural Philosophy, Part II.

APPENDIX E.

ON FORM.

The word *Form* is unfortunately one of the most ambiguous Terms in the English language. For without reckoning its applications in ordinary life; its senses of a form to sit on, i. e. a board; a form in a school, i. e. they who sit on the board; form of a limb, i. e. its shape or figure; form of words, i. e. fixed and unchanging language; form of application (a modification of the last); form in casting, i. e. the mould; and I dare say there are many others; there are also several applications of the Term in philosophical language which render it extremely difficult to speak clearly concerning it. One source of confusion we may get rid of directly. *Form*, physically speaking, is the outward, the visible development of any substance; metaphorically speaking, it is just the contrary; it is what one does not see; it is the cause of the external development; it is the thing of which outward figure is the result; perhaps only the sign. This is but a rough distinction, and will require farther modification. In the language of the schools, Form is the *Natura naturans*, the Nature which produces, which causes substances to differ one from another; which is the agent by whose means kinds and classes are distinguished from each other: wherefore forms are sometimes called "differentiæ veræ." It was this vague conception of the inner Nature which Bacon seized on, and has made so prominent in the Novum Organon. Although his language is by no means clear, his "Form" of a Nature is something far beyond what we now mean by a "Law of Nature." It meant the hidden life (if one may so speak) of each class; its "fons emanationis," from which it flows; which also always grows with the growth; and decreases with the decrease of the Nature, whatever that Nature may be. (Nov. Org. II. 1, 4, 13, 15.) At the same time it is not to be forgotten, that Bacon also expressly states that he regards "Form" as the same thing with "Law." "Nos autem, quæ de formis loquimur, nil aliud intelligimus, quam leges illas et determinationes actus puri,"

&c. (II. 17.) Hence some have been led to affirm that wherever he writes "Form" we may read "Law" (in the modern acceptation of that term); but this is scarce fair; as it seems clear that by "lex actus puri, &c." he really means far more than would be meant now: and this is confirmed by his language respecting Optics in the De Augm. Scient. Bk. iv. where he shews that he would never have regarded the Laws of Incidence and Reflection as "Leges," or Forms. By "Law of Nature;" we mean summary statements of the observed facts and processes of Nature; but Bacon meant the inner life of things: our Laws involve the notion of *operation*, movement, change; his do not; they are rather the conditions of the existence of kinds, and are irrespective of all production or process. So that when Bacon writes (II. 17.) "Itaque eadem res est *forma* calidi, et *lex* calidi," or "coire in *formam* sive *legem*," we must be cautious lest his language leads us to think that his *Form* was equivalent to our *Law*. I am aware that in this I do not agree with that great authority Dugald Stewart; in his Philosophy of the Human Mind, part II. chap. iv. sect. 1. (note), he expressly says, that in reading Bacon's philosophical works, "the word *Law* may be substituted for *Form*, wherever it may occur." I doubt not the substitution would make good sense, would simplify matters, and relieve Bacon from a charge of having clung to an impossible conception of the end of Human Knowledge: but I doubt whether it would any longer represent Bacon's real meaning. And for this we may appeal to his own words. "Quod in Natura naturata *lex*, in Natura naturante *Idea* dicitur," he says in one place; a phrase which, stripped of its scholastic dress, seems to mean that the real cause of any class or kind, that which brings it to be what it is, is Idea or Form, (in natura naturante,) while Law is the expression of the same thing after the process is completed (in natura naturata). "Form" or "Idea" looking at any class objectively, "Law" at it subjectively: it may be more than this; but it cannot be less; it is at any rate more than *Law* in our present acceptation of the Term.

Having then laid it down that *Form* is not *Law* in our sense of the Term, we may go on to ask, whether it is possible to

approximate, according to modern ways of thought, to Bacon's conception of Form.

This may be tried in two ways; either by looking at the distinctions he draws between the different kinds of Form, (II. 17, 26.) or by regarding the relationship in which, in his Method, Form stands to *Latent Process and Latent Structure.*

(1.) We find two divisions of Forms. First, in II. 17. we have true Forms distinguished from *Copulate*, and from *Platonic;* for, Bacon says, "we must take heed lest, in speaking of Forms, we should be thought to refer to those which have hitherto occupied men's thoughts."

Copulate Forms he defines as "naturarum simplicium conjugia ex cursu communi universi." These seem to be results produced by "crossing breeds," by transgressing nature's limits; grafting an apple on a pear stock would perhaps be what is meant. These he promises to consider together with *Latent Process* and *Structure.* The *Platonic* Forms he also rejects; and this distinction is important. Without entering at all into discussion as to what Plato really intended by his ἰδέαι, which would be beside our purpose, it is enough to shew what conception Bacon had of them. He calls them *ideæ abstractæ,* and not limited by matter: i. e. the εἴδη χωριστά, as Aristotle termed them. (cf. De Augm. Scient. IV. iv.) Bacon's Form, then, always resides in the matter of each kind; and when (as in I. 23.) he speaks of "divinæ mentis ideæ," he does not mean to involve any notion of Archetypal Forms emanating from the Divine Mind; but only to affirm that God ("Formatum inditor et opifex," II. 15.) is the cause of, and knows the real and very nature of things, as they are. It remains, then, that *Form* in Bacon's language means the very and inmost nature of things: neither the "Law of Nature" to which things are obedient, nor the "Archetypal Forms," being the same thing: the former is below, the latter beyond Bacon's conception.

There is still the other division left. This is found II. 26; where he is describing "Constitutive or collective Instances." For these he apologizes; they are low, "postulat res et infirmitas humani intellectus, ut *formæ particulares* .... notentur." And he afterwards calls them *formæ minores:* and from his

illustrations it is clear that he meant by them very nearly what we mean by laws; i. e. "general facts, or laws of some degree of generality, which are themselves results of Induction." Such would be Kepler's Laws of Motion, the Law of double Refraction in Optics, &c. This division is more to be noticed, as it seems to me to settle in the negative the question as to whether by *Form* in its higher sense, Bacon did or did not mean what we mean by *Law*. Having then thus distinctly marked off the "Laws of Nature," (tanquam Formas minores,) it only remains for us to see whether by comparing *Form* with *Latent Process* and *Structure*, we can obtain a clearer notion of it.

(2.) By *Latent* Bacon means such intimate and subtle works of nature as escape the ordinary eye; things which are partially revealed by microscopes, by electric agencies, &c. These he divides into two: *process* or growth; as when a plant goes on putting forth buds and shoots and leaves continuously, and yet so gradually as to escape notice except in longer intervals of time. As I have said elsewhere, the Calculus furnishes us with expressions for such secret movements of things; and we have now more knowledge of the expression than of the thing itself. The other work of nature is termed *Structure*, and is the inner composition or arrangement of Atoms of bodies, as they are found in Nature. Such, for example, as the arrangement of particles in crystallography; or of the particles of blood, &c.; the subtle laws of composition which things follow. For these the Microscope has proved most useful.

If neither of these are Form, what then is left for Form? Without answering that there is nothing, (as some would do,) it must be confessed that the discovery of *Latent Process* and *Structure* has practically been successful, while that of Form still remains where it was. The problem of life and of very being is one which scarcely admits of solution here. There is a dark mist drawn across the extreme limits of our knowledge. *Form* is the cause of *Process* and of *Structure*. The crystal is (e. g.) cubical, because of the structure of its particles; but that structure is not the ultimate fact: there must be a cause for it in Nature. The blood is vitalised in a certain way, is

purified by Oxygen, &c.; these are facts of process and structure; but why should the blood flow at all, and what is the principle of Life which causes it? and why is the blood of man clearly distinguishable from the blood of beasts? The answer to these questions would bring us nearer to Baconian Form. For though he sometimes leads us to think that his Form is only high and successful generalization, (I. 103–105,) yet his ambition was something higher than this; and he yearned to learn the secret things of Nature; to trace the very hand of God, who in His mercy has made all things good.

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p. 141. note 17. (line 8.) for "a specimen" read "specimens."
p. 172. note 87. (line 5.) for "Animalculæ" read "Animalcula."
p. 198. note 41. (line 4.) for "Prærogative" read "Prerogative."
p. 200. line 20. for "utrunque" read "utrumque."
p. 217. heading, for 12 read 27.
p. 223. ditto, for 12 read 31.